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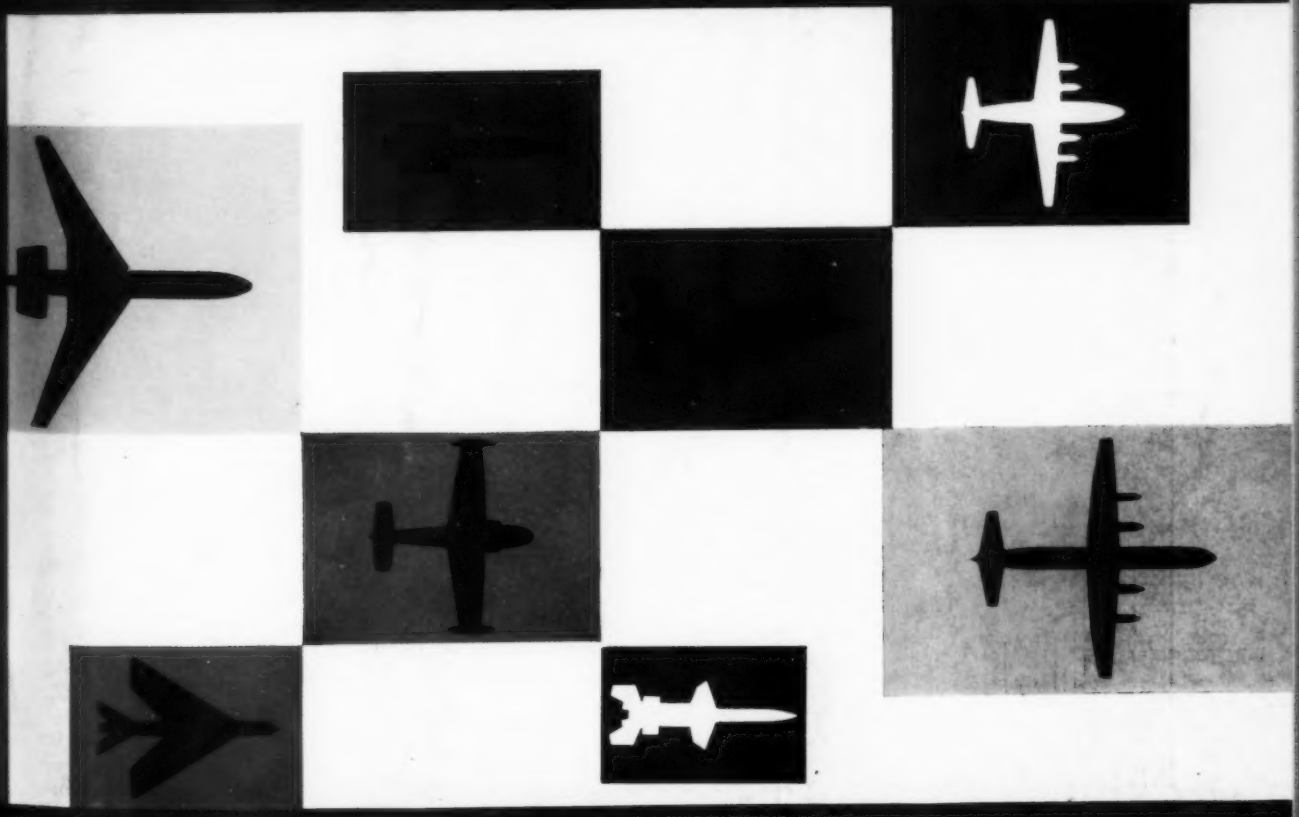

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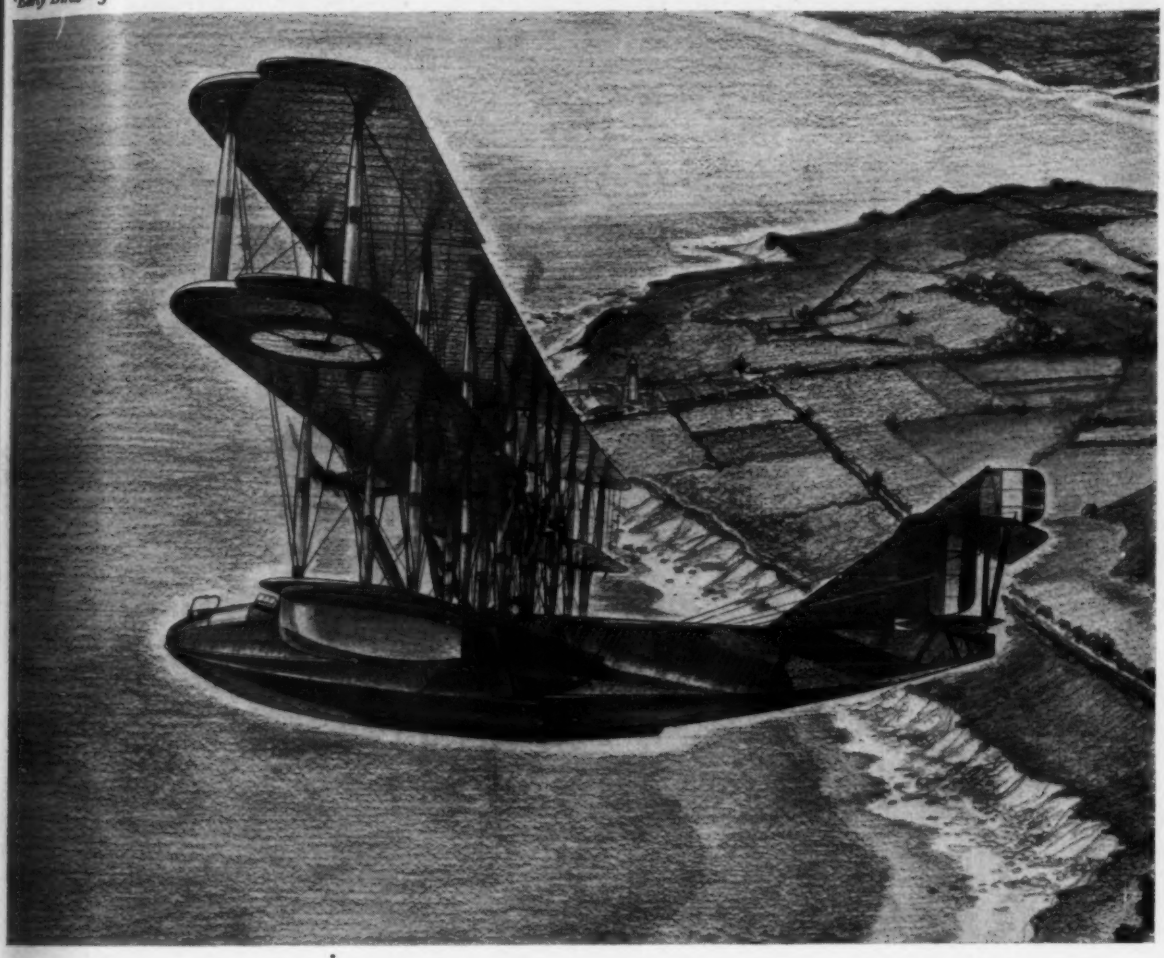

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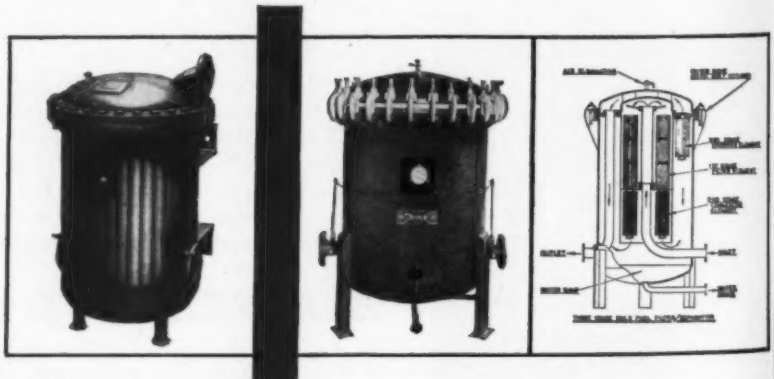

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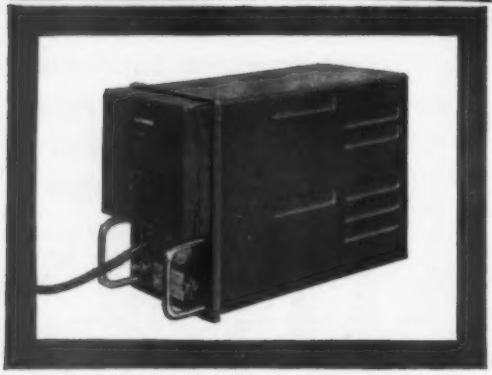

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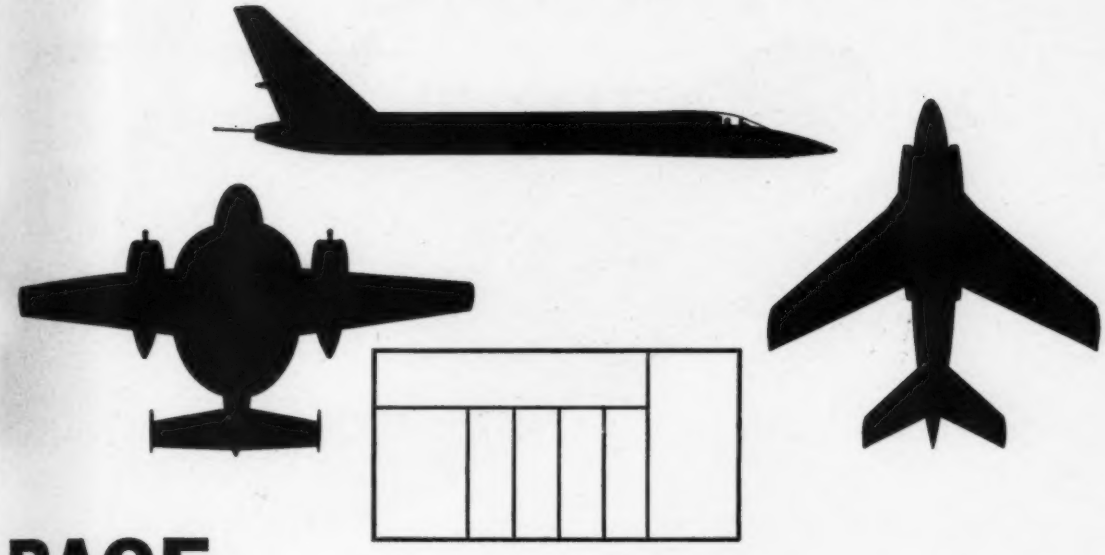

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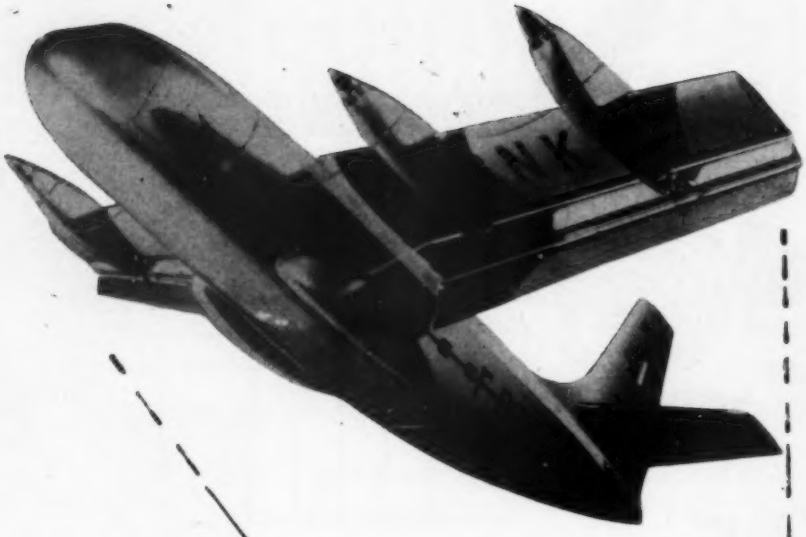

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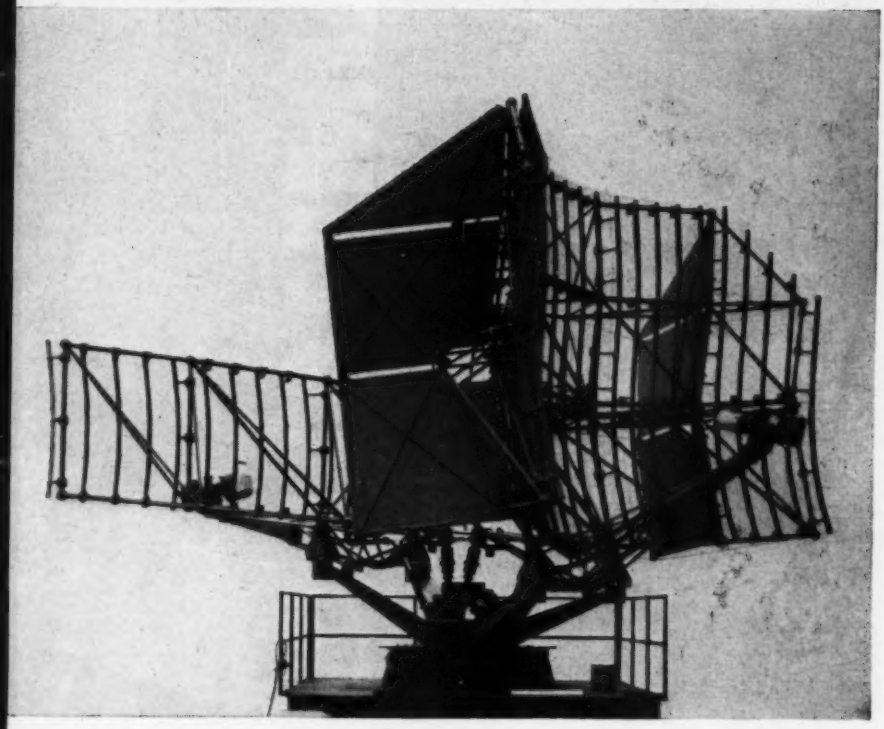

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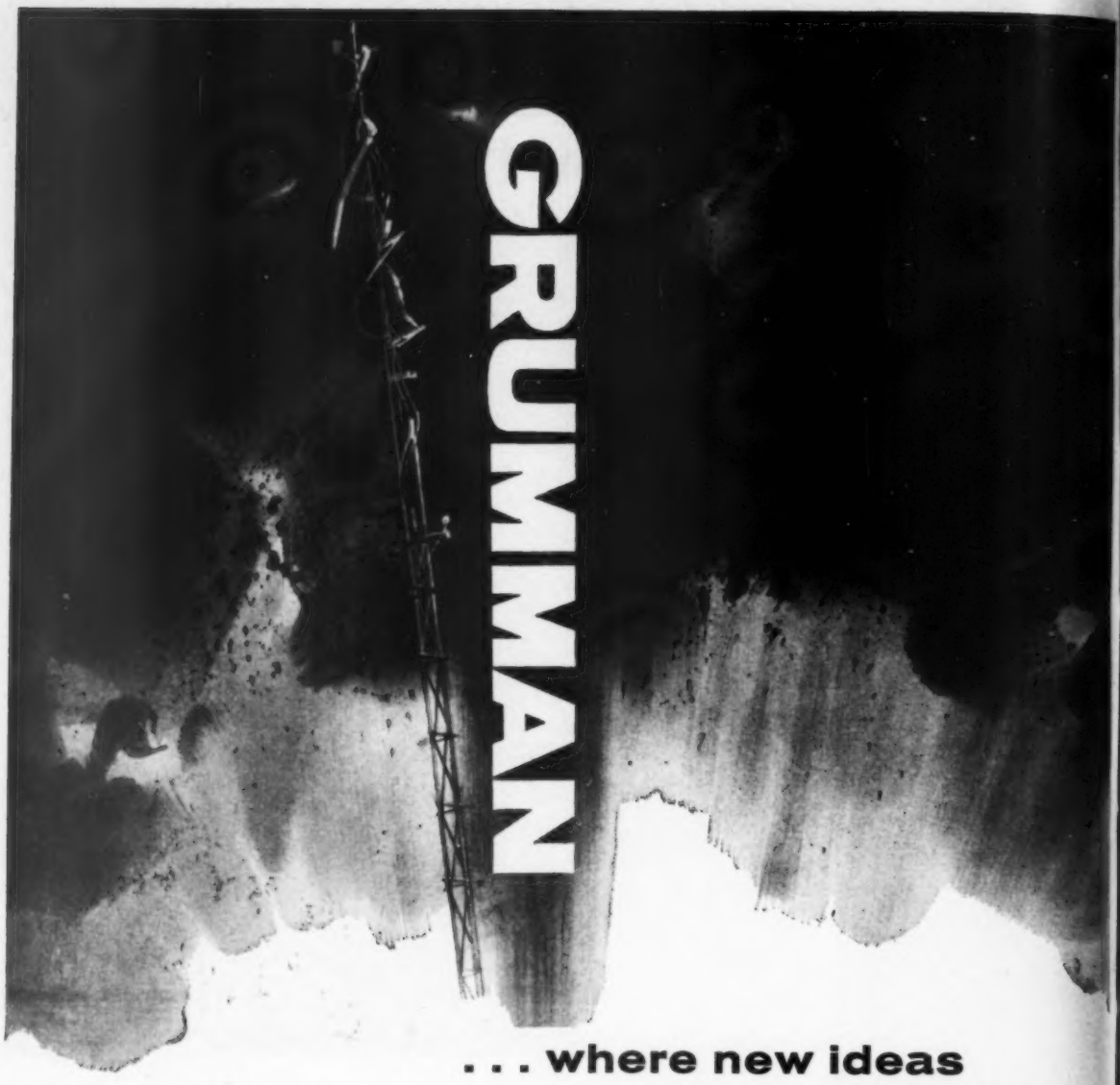

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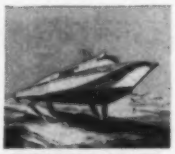

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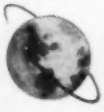

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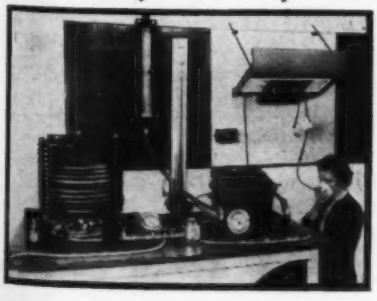

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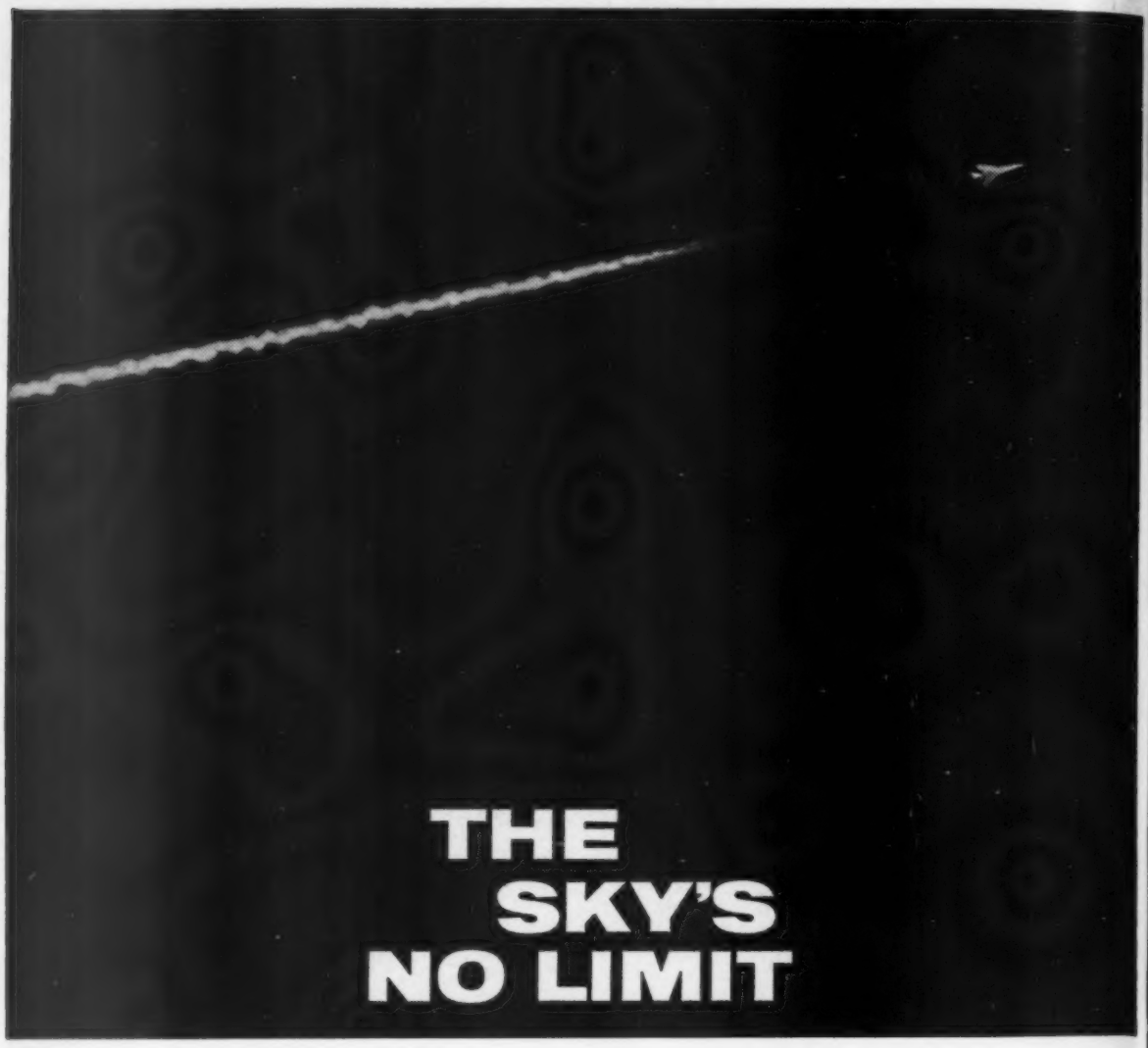

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A Special Piquancy

NAME a significant modern aircraft, engine, missile or accessory and it will probably be at the 24th Paris Salon, which opens tomorrow. More broadly than ever before this greatest aeronautical show on earth will mirror the international aeronautical scene. American aircraft that have hitherto been merely exciting names to most of us in Europe—among them the USAF's Hustler supersonic bomber, its US Navy counterpart the Vigilante, and the slick executive Sabreliner—will be seen in shiny reality. British representation, as detailed in this issue, will be impressive and businesslike, with the Short SC.1 representing a new bold step along the VTOL road. This follows four years after the altogether astonishing demonstrations by the SNECMA Atar-Volante—the unforgettable spectacle of a man apparently walking in the sky. Though VTOL in France has not yet fulfilled the promise of that pioneer companion of the Rolls-Royce Bedstead, new STOL techniques are being perfected by Breguet.

The name Atar is still current, though not in a VTOL context. The connection is, in fact, one which brings no joy to British hearts: this elderly French turbojet is to be licence-built in Australia—for French Mirage fighters—for the *Royal* Australian Air Force. Nor is this order the only manifestation of French infiltration into Australia. The Super Broussard and Rallye are challenges that for the present Great Britain is unable to meet. As for the Caravelle, it has given the world a new lead in aircraft design, and M Hereil and his Sud technicians (and patent agents?) will often raise an eyebrow as they examine the models of the new airliners of other nations. Certain of the models will represent short/medium-range turbofan airliners. Russia will send a short/medium-range turbofan airliner.

These reflections give a special piquancy to the wondrous banquet that is the Paris Salon.

Keep It Brief

WHEN the Air Transport Licensing Board was created last year Parliament intended that British air transport should be spared the ponderous machinery typified by the US Civil Aeronautics Board. Britain's new Board is still feeling its way, but already there are signs that its proceedings are becoming over-heavy. True, the Cunard Eagle North Atlantic case that began last week, and which we review in this issue, is not one to be treated lightly. But one may ask if it is really necessary (for example) for BOAC's hired counsel to spend a good hour solemnly and laboriously contesting a Cunard Eagle traffic forecast. Everyone knows that one air traffic forecaster can never meet another without laughing. One might as usefully argue about next week's weather. Counsel, Mr Henry Fisher QC, could have dealt with this particular subject in 15 minutes. We cite this as one example only of numerous points that could have been disposed of without hair-splitting and pedantry. That such wrangling should have found a place in an air transport courtroom is the fault of those airlines who decided to brief counsel instead of fielding their own men, as Cunard Eagle have done.

Everyone admires counsels' aptitude for grasping specialist subjects. But their knowledge cannot range beyond the brief given them by the specialists. These men, the briefers, are really the ones who should be the advocates. If this is not to be, then at least let there be included in counsel's brief an admonition to keep it brief. The Board and British air transport have a big job to do, and cannot afford to have their time wasted.

FROM ALL QUARTERS

WHISKY ALPHA views its new locale from low level: Jersey Airlines' first Herald, G-APWA, the 100-Series demonstrator leased from Handley Page until the airline's Series 200s are delivered ("Flight" last week), at Jersey Airport prior to the inauguration of scheduled services last Friday "Flight" photograph

Short Bros Chairman

Mr C. E. Wrangham

WITH the Minister of Aviation's approval Mr C. E. Wrangham, CBE, BA, is to be appointed chairman of Short Brothers and Harland. Mr C. F. Uwins, OBE, AFC, who has held the post on a temporary basis since September last year, is to remain a director of the company. Mr Wrangham was until recently deputy chairman of Davy-Ashmore Ltd and also a director of Simon-Carves Ltd, but has now retired from those boards. During the war he was Principal Officer for Aircraft Equipment in the MAP.

Avro Chief Engineer

IT is announced that Mr M. J. Brennan, BSC, MIMECHE, FRAES, director and chief engineer of Folland Aircraft, has been selected as chief engineer (aircraft) of A. V. Roe & Co. He succeeds Mr Roy Ewans, whose resignation was announced recently (*Flight* last week).

Mr M. J. Brennan

Mr Brennan joined Folland last year as director and chief engineer, having been with Vickers-Armstrongs (Aircraft) for the previous ten months as an assistant chief engineer. Before that he was with Saunders-Roe for 23 years, joining the company in 1936 and becoming chief designer in 1952. Among his responsibilities were the Princess flying boat, the SR-177 and the Black Knight programme. He also worked on the design of the SRN-1 Hovercraft. He resigned from Saunders-Roe in 1959 three days after the chief rocket development engineer, Mr Paul Layton, resigned "as a protest against Britain's lack of a space exploration policy." Mr Brennan said at the time that his own decision was totally unconnected with that of Mr Layton, commenting that he had resigned to make himself available for appointment with "one of the larger aircraft companies."

Blackburn Board Changes

FOLLOWING the appointments of Mr N. E. Rowe as full-time director of Hawker Siddeley Aviation and of Air Cdre F. R. Banks as chairman of ATS Co Ltd (referred to on this page and in the May 11 issue), changes have been announced in the Blackburn Aircraft board. Capt E. D. G. Lewin, CB, CBE, DSO, DSC, RN (Ret), previously joint managing director with Mr Rowe, becomes managing director; Mr B. P. Laight, previously director and chief designer, becomes director and chief engineer; and Mr R. H. Stone, previously director and secretary, becomes financial director and will continue to act as secretary for the time being. The board is now as follows: Sir Roy Dobson, chairman; Mr A. F. Jopling, deputy chairman; Capt E. D. G. Lewin, managing director; Mr T. Bancroft, production director; Mr B. P. Laight, chief engineer; Mr R. H. Stone, financial director; and Marshal of the RAF Sir John Slessor.

SKYKNIGHT is the name of this newcomer to the Cessna range, powered by two 260 h.p. Continental fuel-injection engines fitted with turbo-superchargers which confer a service ceiling of 27,200ft and a single-engine ceiling of 17,400ft. As reported on page 720, deliveries will start in August. Top speed is 265 m.p.h. and selling price is $67,500

Atars for Australia

IT was announced in Canberra on May 17 that, after a protracted evaluation, the Australian Government had chosen the French SNECMA Atar turbojet as powerplant for the Mirage IIIs for the RAAF. Senator Harrie Wade, Minister for Air, said that, although the "claimed increases in the performances and development potential" resulting from the use of the Rolls-Royce Avon Mk 67 had justified tests and flight trials with an Avon-Mirage, there would have been "considerable additional cost" in adopting the British engine.

What really seems to have swung the scales against the Avon, however, is the promise of further Atar development. SNECMA have made detailed presentations of a new variant designated Atar 9K. No details of this engine have yet been divulged. It is difficult to see how SNECMA can "stretch" the existing Atar 9C/9D series any further without either adopting cooled blades (for which there is no production experience in France) or accepting a very poor overhaul and parts life. It is likely, therefore, that the 9K may have a "zero-zero" stage on the compressor, which means that it is unlikely to be ready for service for some two years. If this is the case it may not worry the Australians greatly, for the Mirage programme is a lengthy one. Commonwealth Aircraft will make the Atar at Fishermen's Bend. A choice between the existing Atar 9C and the new 9K is promised "within four months."

New Rolls-Royce Offices

AT Derby recently Mr J. D. Pearson, chief executive of Rolls-Royce, formally cut the first turf on the site of the company's new engineering and main office block about a mile from the Nightingale Road factory.

With 250,000 sq ft of floor area, seven three-storey air-conditioned blocks will make it possible to bring together the various engineering departments at present housed in separate premises in the neighbourhood. Some 2,000 people will work in the new offices, the cost of which is likely to be over £2m.

HSA Posts

TWO senior appointments are announced by Hawker Siddeley Aviation Ltd. Mr N. E. Rowe, CBE, DIC, BSC, MIMECHE, ACGI, MINSTT, FCGI, FRAES, FIAES, WHEX, has joined the board; and AVM A. A. Adams, CB, DFC, RAF (Ret) has been appointed HSA regional executive (NATO) and will be based in Paris from June 1.

Mr Rowe has relinquished his appointment as joint managing director of Blackburn Aircraft and has also resigned various directorships with all the Blackburn companies. In his HSA appointment he will be a full-time director, working with Mr S. D.

Davies, technical director (aircraft). Mr Rowe joined Blackburn and General Aircraft in 1952 as technical director, having previously been with BEA as controller of research and special developments.

Mr N. E. Rowe (left) and AVM A. A. Adams

From 1924 to 1946 he held various technical appointments with Air Ministry and the MAP.

AVM Adams was Chief of Staff, Far East Air Force, until his retirement from the RAF in November 1959. Since that date, he has been associated with McDonnell Aircraft Corp in the UK.

Weybridge Posts

TWO senior appointments are announced by Vickers-Armstrongs (Aircraft) Ltd. Mr A. W. E. Houghton, who has been general manager since June 1957, becomes assistant managing director; and Sir Geoffrey Tuttle, KBE, CB, DFC, FRAeS, a director since October last year, is now general manager. Both appointments were effective from May 8.

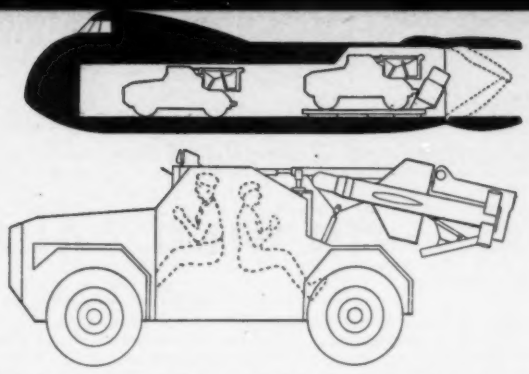
Mr A. W. E. Houghton (left) and Sir Geoffrey Tuttle

Mr Houghton joined the company as a junior fitter in 1922; he was made a special director in 1955 and two years later appointed to the board. Sir Geoffrey Tuttle went to Vickers after a distinguished RAF career, his last service appointment (1956-60) being that of Deputy Chief of the Air Staff.

RAeS Honours

FURTHER details of this year's Royal Aeronautical Society awards, in addition to the Honorary Fellowships (this page, last week), are as follows:

Honorary Companionship: J. N. Toothill, CBE, director, Ferranti Ltd, Hollinwood, Lancs, and general manager, Ferranti Ltd, Edinburgh; silver medal: R. Hafner, FRAeS, technical director (research), Westland Aircraft, for his outstanding work in the design and development of rotary-wing aircraft; bronze medal: L. Haworth, OBE, BSC, FRAeS, MIMechE, assistant chief engineer, propeller turbines, Rolls-Royce, for his work leading to advances in aircraft gas-turbine design; British gold medal for aeronautics: Dr S. G. Hooker, OBE, BSC, ARCSC, DIC, FRAeS, MIMechE, technical director (aero), Bristol Siddeley Engines, for his outstanding practical achievement in aero-engine design and development; British silver medal for aeronautics: Pierre Satre, technical director, Sud-Aviation, for his practical achievement in aircraft design, with special reference to his development of the rear-engined configuration; Wakefield gold medal: Dr E. Eastwood, director of research, Marconi's Wireless Telegraph Co, for his contributions towards safety by the development of air traffic control and navigational aids; R. P. Alston medal: R. P. Dickinson, BSC (ENG), AFRAeS, Superintendent, A&AEE, Boscombe Down, for his practical achievement in the execution and direction of flight test observation work; N. E. Rowe medals: J. Wilding (21-26 age group) for his paper *Bird Flight and the Aeroplane* and W. Bishop (under 21 group) for his paper *The Development of Tailless Aircraft and Flying Wings*; Alan Marsh medal: Jack Brannon, a pilot with Bristow Helicopters, for his evacuation of an injured oilman from the offshore drilling rig, de Long 144, to Abadan Hospital during the night of January 26, 1960; and Alan Marsh award: M. S. Eden, a former Saunders-Roe apprentice now at Cranfield.



MALKARA MK I, the heavy anti-tank missile of the British Army, is to be deployed aboard a new air-portable launcher vehicle which carries four. In the AW.660 Argosy elevation the rear launcher is mounted on an air-dropping platform

IN BRIEF

2nd ATAF won the Allied Air Forces Central Europe reconnaissance competition Royal Flush VI, held at Beauvechain, the Belgian Air Force base, last week. They scored 9,970 points against 9,807 by 4th ATAF.

A new world speed record for helicopters, 192.9 m.p.h., has been claimed by the US Navy. It was set up on May 17 by Cdr P. Sullivan and Lt B. Witherspoon in a Sikorsky HSS-2. It betters by 26 m.p.h. the existing record, 166.5 m.p.h., set up by a Russian Mil-6 in November 1959.

A subsidiary called British Aircraft Corporation (Australia) has been formed in Australia by BAC with a capital of £80,000. The chairman is Sir Daniel McVey, Australian Director-General of Civil Aviation from 1943 to 1946, and the managing director Mr A. W. Millson, a director of Vickers-Armstrongs (Australia) Pty Ltd.

All major publicity activities of Hawker Siddeley Aviation are in future to be dealt with at a new central department established in London. It is headed by Mr C. A. G. Hicks, formerly aviation sales administrator; and Mr J. K. Corfield, AWA publicity manager for the past three years, has been made public relations manager. The latter will be assisted by Mr David Masters, formerly Fairey Aviation production test pilot at Manchester, who becomes technical press officer. Headquarters for public relations, publications and advertising are at Hawker Siddeley House, 18 St James's Square, London SW1 (Whitehall 2064); the exhibitions section is at present operating from the international sales offices, 32 Duke St, London SW1 (Whitehall 6177).

CITATION awarded to Mark Lambert of "Flight" in the Sherman Fairchild Flight Safety Writing Competition being accepted on his behalf in New York by Sir Berkeley Ormerod, public relations director of British Information Services. At left is Mr Ansel Talbert, vice-president of FSF, and at right, Mr Sherman Fairchild

CHAIRMANSHIP at the RAeS, where last Thursday a presidential chair for the Society's new lecture theatre was presented by Sir Roy Fedden (right) to the president, Dr E. S. Moult. The chair, of teak with blue leather handsomely tooled in gold, is representative of flight from the days of Montgolfier to the Sputnik

Missiles and Spaceflight

IN-SILO LAUNCH

Vandenberg Air Force Base, California, May 3.

AMERICAN missile-world stock rose sharply on the heels of a successful "in-silo" launch of a Martin Titan I ICBM from the bottom of a Titan II development silo. The fact that it was a Titan I which rose from a Titan II silo needs a brief explanation. Titan I is the second large American ICBM, built originally as a back-up to Atlas. Like Atlas, the Titan I uses cryogenic fuel, a mixture of liquid oxygen and RP-1 (Rocket Propellant 1, a refined kerosine). Titan I is moving to the end of its R & D phase before becoming operational with SAC squadrons alongside Atlas (*Flight*, November 4, 1960, page 717).

Since the American defence posture is based on defensive firings in the event of attack, most Atlases and all Titans are being put into hardened underground silos theoretically capable of withstanding atmospheric overpressures of some 300lb/sq in, corresponding to a near miss with a 10MT nuclear warhead. The USAF, conscious of the critical time consumed in fuelling a missile above or under the ground, has insisted that missile makers reduce the "reaction time" and find ways to move the birds quickly. Hence the appearance of the Titan II, using storable propellants—akin to nitrogen tetroxide and hydrazine—which can be left indefinitely inside the missile tanks. The Titan I is stored and fuelled underground, but when fully loaded has to be laboriously raised to the surface on a hydraulic lift before it can be fired. Launching a missile from the bottom of the silo eliminates both the time taken to reach the surface and the "soft" exposure time, so Martin's designers at Denver have to make Titan II lift out of its 146ft deep hole. There is a lot of thunder and 5,000°F flame when a 300,000lb rocket engine is ignited. A fully loaded Titan I spread large lumps of concrete silo facing and lift machinery around the Vandenberg countryside last December, when its silo lift broke, allowing the 220,000lb missile to fall a few feet to the bottom. The exercise was proving the silo systems before attempting a launch from the surface. The silo from which the pieces came has been abandoned, although the old control centre is being linked to a new firing shaft. There has not yet been a Titan I firing at the surface of a silo.

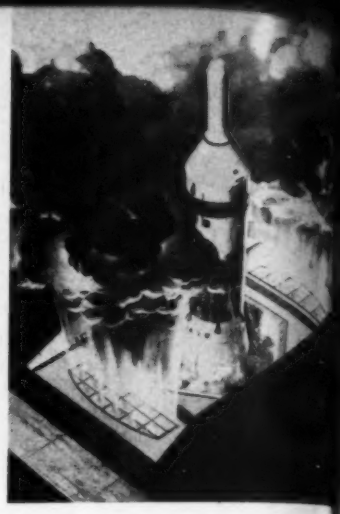
To Prove Feasibility

Obviously the time had to come when it could be proved that a liquid-fuelled ICBM could be fired from the bottom of a hole; and the time to do this is before the missile is in production and the silos to house it are built. There is no plan to fire production Titan Is from their silos. It is interesting to note that the solid-propellant Minuteman—despite its being the newcomer in the ICBM field—has already been fired in tethered first-stage boilerplate form, from out of a silo at Edwards Air Force Base. The February launch of all three stages from Cape Canaveral was cheating, in that the highly successful firing was from the surface.

Since Titan II is not yet ready, and the programme of concurrency demands the construction of hardened sites during the R & D stages of the missile, something else had to be fired from a Titan II hole to prove the system. The obvious answer was to use a Titan I, which has a first stage of the same diameter as Titan II and fits into the latter's hole with little modification.

There had been much speculation among journalists upon whether or not the in-silo Titan firing would be open or closed to them. Naturally, the recent flurry of criticism about President Kennedy's "secrecy policy" gave rise to such doubts, but notice that accredited correspondents were invited came about 24hr before scheduled launch time.

At the pre-launch briefing it was learned that the missile to be fired was a Titan I first stage on which a dummy, water-ballasted second stage had been fitted. Guidance control for the launch would be internal autopilot only, since the short trajectory planned did not need normal Titan I radio command guidance. (Titan II will use a new all-inertial guidance system, to allow more than one missile at a time to be fired from a complex and avoid radio jamming of the control system.) The planned trajectory was to be terminated by a deliberate destruct at 140sec after launch. There would be no attempt at stage separation and ignition—difficult, with a water-filled dummy. US Air Force Col John C. McCloy, project officer for the Titan, outlined two test objectives for the shot. The first was to test structural integrity of the missile on being fired out of its hole, and the second was to test the Pacific Missile Range safety destruct system. Since the latter depended on the missile blowing up, this provided a fine reason for destroying the bird after a short flight. The Colonel briefly told his Press gathering, 105 strong, that 96sec after firing, at an altitude around 200,000ft and 20 miles out, the autopilot system would be left in a coarse operating mode and not trimmed back to fine. This would subject the missile structure to abnormally high loads when responding to autopilot attitude-correction signals, to the point where it "may tumble end-over-end." That the airframe, if excessively weakened by heat during the launch, would break up went unmentioned. The second test objective would come 140sec after launch, when the missile would be blown up, by the Navy. The US Navy operates the Pacific Missile Range, and the Air Force and other services are "users." Destroying the missile, about 40-50 miles out at approximately 250,000ft, would test the range safety destruct system; left alone, the dummy second stage would travel about 350 miles. The writer would not suggest that this was merely a convenient way to terminate the flight and save embarrassment should it fail to go an appointed distance. Distance or no distance, the subsequent launch was a remarkable achievement.



Artist's impression of Titan firing from silo: the two exhaust outlets can be prominently seen, together with the silo doors, designed for an overpressure of 300 lb/sq in and weighing 200 tons

Some background on what is entailed in firing from down in a hole is valuable at this point. Aerojet-General, makers of the Titan's twin-thrust-chambered first-stage engine and single-chamber second-stage engine, spent two years investigating problems surrounding silo launching to provide the criteria for both operational missile and silo design. One-sixth-scale Titan models were used, with Nike Ajax engines operating on storable propellants (probably unsymmetrical di-methyl hydrazine and nitrogen tetroxide). Tests were run from several positions in a small test silo: at the bottom, one-third of the way up, and 80 per cent of the way up. The information provided by cumulative testing of the acoustic and flame characteristics led to the design of the silo exhaust system, in which the missile rests at the bottom of an octagonal-section hole at the apex of a W-shaped flame deflector. Two exhaust vents run from the deflector up the side of the silo and vent to atmosphere at ground level.

Uncontrolled acoustic energy from the main motors is sufficient to destroy the missile as it passes slowly up the long silo. Space Technology Laboratories (STL), responsible for systems engineering and technical direction of the entire Titan programme, spent two years studying the severe acoustic problems peculiar to silo launches. From months of work in test chambers equipped with sirens simulating launch noise, STL (surely somewhat deafened by this time) were able to establish the vibration levels experienced inside, and just above the mouth of, the silo. Vibration in the silo was damped by fastening 3ft-thick fibre-glass acoustic liners to the steel-plated walls of the silo, and a heat-resistant liner along the twin exhaust ducts. The first complete silo launch test facility (SLTF) at Vandenberg was tested on April 24, 1961, using the same missile launched on May 3 at full power while anchored down. Damage to the silo and test missile must have been negligible for the launch to have been held at the same site nine days later.

As with any other launch, the time between briefing and liftoff hung heavily for the onlookers. Everyone was aware that the Redstone-Mercury, with its grounded astronaut, was sweating out the weather in Florida. It even looked as if the Titan shot might be put off for the same reason. Florida and California, of all states in the Union, are accustomed to basking in the sun; yet Cape Canaveral was out of weather, and a steady thirty-knotter was blowing at Vandenberg. The PA system announced that, if the launch were delayed much past the noon schedule, the high gusts forecast could put the whole event off for quite a while. The count-down still went on. One hour before T-time (any Britisher is naturally bewildered by this) the Press were bussed out to the vantage point reserved for them on a high ridge 10,000yd from the launch point. With the tension rising, straining one's eyes, while being sand-blasted by unaccustomed wind and looking at a red blinking light two miles away, the distance seemed greater. A moment's reflection on the dangers of proximity should something happen, and the two miles seemed less.

The holds were short, and the count kept picking up where it left off. At T-3min even the most cynical had left the protecting cover

of the buses and were straining their eyes with the rest—only to wait out a planned hold for checking all information. The range was clear, and the count continued. Usually the 10–9–8 drama is heard over the loudspeakers, but this was drowned by the wind.

Right where it was supposed to be, a sheet of bright orange flame shot up. We had been forewarned that the first-stage engine would be fired for 3sec with the missile tethered, as a precaution against an abort due to power failure, before the bird was released for its 5sec journey out of the hole. The dummy re-entry vehicle and second stage appeared, seemingly bathed in smoke and flame—actually several feet away on each side. By the time the whole missile had emerged little could be seen through the smoke; the noise was apparent, but much diminished by the force of the wind. It is hard to be emotional—except in a negative way—about missiles; but at the same time it is a gripping experience to witness a 98ft, 110-ton Titan come belching out of the ground, and go straight up, and up, and up into a cloudless blue sky.

Seconds after launch only a small orange flame was left, seemingly dangerously overhead for something going to be "destructed." As the bird passed through what someone said was the ionosphere, the flame turned into a stream of smoke, the trail quickly changing from white to brown. Nine-six second point went by, and the Titan was going as straight as ever. At last it turned over into an obviously curved trajectory—but then the smoke-trail stopped abruptly. We waited for the obvious explosion but none came. Seconds later a small white ring of light or smoke was briefly visible, and then disappeared. The Navy had not been disappointed, and had blown up their colleague's effort; it is not often that a rival service gets such an opportunity.

That the launch was a success was obvious, and the 13 "mobile phones" at the Press site were telling the world about it.

Time for launch was posted as 13.10.52; few of us were used to such precision. First Air Force photo prints, still wet, showed a line running from the top of the fully emerged second stage down to the ground. This turned out to be a 100ft umbilical cord for instrumentation, a piece of wire forming an excellent back-up in case the telemetry should fail. Looking down the silo hole a couple of hours later, from a very steeply banked C-47, we saw that the mouth at least, had suffered no obvious damage other than discoloration. The show was over, and the idea worked.

IAIN PIKE

MERCURY IFS AND BUTS

PRIMARY feature of National Aeronautics and Space Administration planning of the first manned ballistic flight in Project Mercury was that all possible precautions were to be taken to ensure the safety of the astronaut. As an answer to the many "What if . . ." questions asked at the time of Cdr Shepard's flight on May 5, we reproduce here in its entirety a paper entitled "If—a Study of Contingency Planning for the Project Mercury Mission" written by members of the NASA Space Task Group responsible for the project.

In any research and development programme (says the NASA study) in which the state-of-the art is being pressed or is about to be surmounted, there is always an undetermined number of "IFs" or unknowns. Project Mercury is just such a programme. Its purpose is to investigate man's capabilities—perhaps to confirm those capabilities—in space.

In Mercury, extreme efforts have been made to attempt to insure operating reliability mission success and pilot safety. But these are mechanical, man-made pieces of equipment and are therefore subject to malfunction. Many repetitive or back-up systems have been built into the Mercury spacecraft and related equipment. From pre-launch until safe recovery, hundreds of different possible contingencies have been anticipated. For example, in the Redstone-boosted flights, IF . . .

. . . space vehicle-to-ground connections indicate an unsafe condition in the booster before lift-off and umbilical disconnect, the escape system can be fired on signal from the blockhouse through the launch vehicle or through the spacecraft umbilical line.

. . . an unsafe condition is indicated before lift-off but after ground umbilical disconnect, the escape system can be fired by a signal from the blockhouse ground-command equipment or by the astronaut in the cockpit.

. . . an impending catastrophic failure is indicated between lift-off and escape tower separation about 140sec after launch, the automatic abort-sensing and implementation system (ASIS) can automatically initiate an escape sequence to remove the spacecraft from the booster, or the escape system can be fired by ground command from the blockhouse or by ground command from the Mercury Control Center, or by the astronaut in the cockpit.

. . . a mission abort becomes necessary after tower separation, the spacecraft can be separated from the booster by firing the posigrade rockets on the blunt face of the spacecraft, by automatic sequencing equipment, or by the astronaut in the cockpit. Since only about 10sec elapse between escape-tower jettison and spacecraft separation from the booster, a near-normal Redstone-boosted mission is still possible at this point.

. . . the automatic sequencing equipment does not jettison the escape tower, the astronaut in the cockpit can trigger the system manually from the cockpit.

. . . the spacecraft does not automatically separate from the launch vehicle at booster burnout, separation can be initiated by ground command or by the astronaut. The astronaut can initiate separation from the cockpit manually.

. . . the automatic stabilization and control system (ASCS) fails to orient the spacecraft after separation from the booster, the astronaut has two separate manual back-up control systems to achieve proper attitude control.

The success of the mission and the safety of the astronaut also depend on the life-support system, communications, and electrical power. IF . . .

. . . the automatic environmental control system, which provides the spacecraft cabin and astronaut with oxygen and temperature control fails, alternate systems can be selected manually by the astronaut.

. . . the spacecraft pressure vessel develops a leak during flight, the astronaut's full-pressure suit automatically inflates to 5lb/sq in to provide a second closed environment.

. . . the system which supplies oxygen to the astronaut's pressure suit fails, an emergency supply, which is in parallel with the normal supply, automatically cuts into the circuit. The astronaut can start the alternative system.

. . . the spacecraft's main batteries fail during flight, a standby system of 15hr duration capacity is activated automatically or manually by the astronaut.

. . . the astronaut's primary ultra-high-frequency voice link with the ground-tracking network fails, he may switch to a second UHF or a high-frequency channel.

. . . his microphone fails, a second mike in parallel with the first automatically begins to operate.

. . . all voice link systems fail, the astronaut may resort to a code key in the cockpit and use the telemetry transmitters and frequencies to send messages back to the tracking network.

. . . command receiver "A" fails, receiver "B" may be used to receive commands from the ground.

. . . one telemetry transmitter fails, another with four channels will convey aeromedical information and 90 other different measurements to ground-tracking stations.

. . . all telemetry transmission equipment fails, onboard recorders will record and preserve data for use after recovery.

One of the most important phases of the flight is the landing-recovery phase. Although the retro (braking) rockets are not

Countdown complete and first phase of the Mercury-Redstone mission successful: a perfect lift-off from the pad at Cape Canaveral on May 5. Ensuring the safety of astronaut Alan Shepard was the intricate system of checks and double-checks described above

Missiles and Spaceflight . . .

needed on the Redstone-boosted flights to cause re-entry, one of the objectives of these flights is to exercise the retro-rocket system for "in space" qualification. This phase of the flight begins with the establishment of the proper retrorocket firing attitude and ends with the successful delivery of the spacecraft aboard the recovery ship. IF . . .

. . . the automatic attitude control system does not orient the spacecraft to the proper retrorocket firing attitude, the astronaut in the cockpit can assume attitude control through one of two alternate control systems.

. . . the automatic timer in the cockpit does not fire the retrorockets, they can be fired by ground command from the Mercury Control Center; or they can be fired by the astronaut in the cockpit.

. . . the automatic system fails to initiate jettisoning of the spent retrorocket pack, the pilot can initiate the sequence from the cockpit.

. . . the automatic system does not retract the periscope before re-entry into the atmosphere, the pilot can retract it manually.

Since each Mercury manned-mission profile is to be flown unmanned before man can fly the same profile, all systems must be designed, manufactured, and installed in the spacecraft to operate on a completely automated basis. Many of the primary flight actions and systems can be activated or controlled from the ground. However, it has not been possible to provide for ground control over all spacecraft systems. The introduction of the astronaut—the human observation and judgment factor—serves to enhance operational reliability to a great degree. For example, automated electronic equipment which controls the initiation of the landing and recovery aids is duplicated. These systems are installed in parallel so that failure of one system should automatically cause a switchover to the alternate system. IF . . .

. . . these parallel systems fail to deploy the 6ft-diameter drogue parachute at about 21,000ft, the astronaut in the cockpit can deploy the chute manually. At this point, small strips of aluminum (radar chaff) are dispersed to provide a target for radar location.

. . . the antenna canister, to which the drogue parachute is attached, is not jettisoned automatically to deploy the main 63ft ringsail-type landing parachute, the pilot can manually jettison the canister and deploy the main chute.

. . . the main landing parachute does not deploy or open properly, at about 10,000ft, a reserve landing parachute is available and can be deployed by the astronaut in the cockpit.

Recovery from the Sea

When the main landing parachute is deployed, a SOFAR underwater bomb is deployed over the side to provide an audible sound landing-point indication, and an ultra-high frequency Sarah radio beacon begins transmitting. A can of sea-marker dye is deployed with the reserve parachute and remains attached to the spacecraft by a lanyard regardless of when the reserve chute is deployed.

On landing, an impact switch jettisons the landing parachute and initiates the remaining location and recovery aids. These include release of sea-marker dye with the reserve parachute if it has not previously been deployed, triggering a high-intensity flashing light, extension of a 16ft whip antenna and the initiation of the operation of a high-frequency radio beacon. IF . . .

. . . the automatic equipment fails to release the main parachute and jettison the reserve parachute, the astronaut can initiate the systems manually.

. . . the ultra-high frequency Sarah radio beacon fails, the high-frequency radio beacon automatically becomes the primary radio-location aid.

. . . both the UHF Sarah beacon and the HF recovery beacons fail to operate, the astronaut's UHF and HF radio transmitters become primary radio location aids.

. . . all the radio beacon location aids fail, the high-intensity flashing light and sea-marker dye become valuable aids to visual location by searching aircraft and ships.

. . . the spacecraft should spring a leak after landing, or if the life-support system should become fouled after landing, the astronaut can escape either through the upper neck of the spacecraft or through the side hatch.

. . . it becomes necessary to terminate, or if the flight terminates early, inadvertently, elements of the Mercury recovery forces are deployed along the intended flight-path to make the recovery.

. . . it is necessary to abort the mission, either off-the-pad or immediately after engine ignition and lift-off, emergency rescue and recovery crew and equipment have been stationed near the launch area.

The foregoing is not a complete study of all redundant Mercury systems or of all the vexing "ifs" which must be considered in the conduct of Mercury flight tests. It is intended, rather, as a primer for the layman interested in acquiring a basic understanding of contingency planning in the Mercury mission.

During his speech in Ottawa on May 17 President Kennedy suggested a "NATO seaborne missile force." This model, here being inspected by Vice-Admiral John Hayward, US Navy, and Milton Rosen, of NASA, shows an Atlas-Centaur launch installation built on a drydock ship. The model was brought before the House of Representatives Space Committee on May 15

HIGH OR LOW ORBITS?

The relative merits for communications purposes of "synchronous" satellites orbiting at 19,300 n.m. with a period of 24hr, and satellites at lower altitudes, were thoroughly discussed in London on May 12 at the symposium on communications satellites organized by the British Interplanetary Society. Eight listed papers by British and American authors were presented, and a brief contribution was given in addition by Mr Ronald Smelt, chief scientist, Lockheed Aircraft Corporation.

In *Some Practical Problems of Satellite Communication*, Dr J. R. Pierce of Bell Telephone Laboratories, Murray Hill, New Jersey, made the point that the most useful and most economically attractive service that satellite communication could provide was that of linking together the existing, highly developed communication systems of various continents. The speaker maintained that, because of the time delay in transmission, it was clear that 24-hour "stationary" satellites "can never give us quite as good a telephone circuit as those we now have via cable." It had been proposed that non-steerable ground antennas might suffice for stationary satellites, but this appeared impracticable.

Satellite life was a critical problem, Dr Pierce pointed out, and most active space payloads depended on solar cells. Although these cells could be protected against the electrons of the outer Van Allen belt, it appeared impossible to protect them from the protons in the inner belt; this radiation was most intense at about 2,000 miles and extended out to perhaps 5,000 miles.

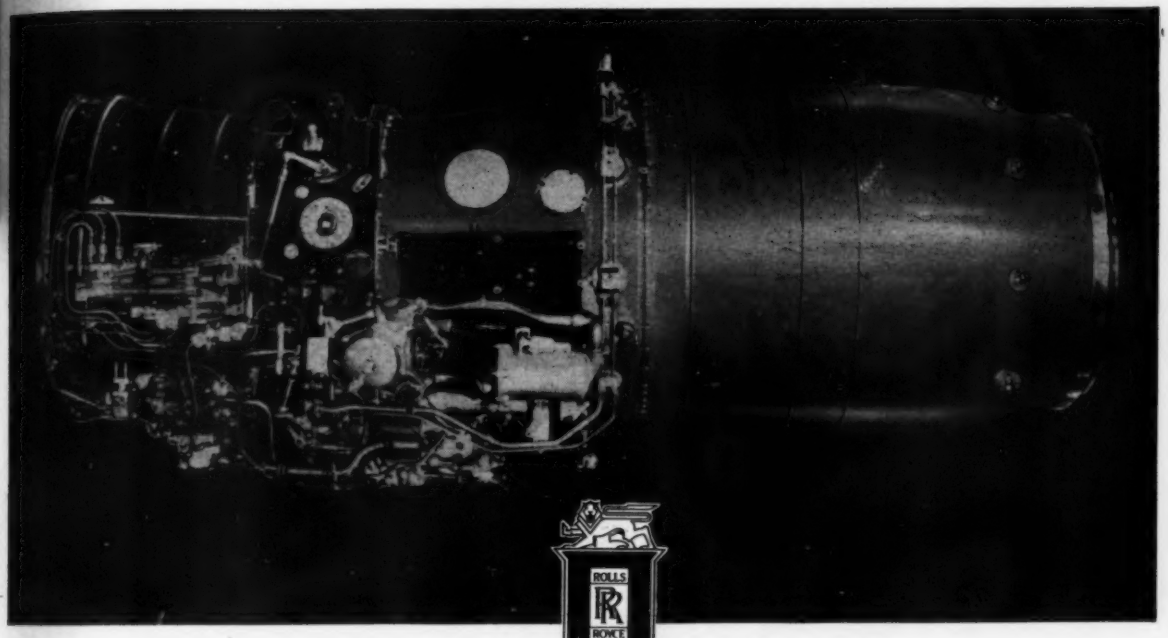
The choice between various possible satellite systems, the speaker said, must depend on the established state of the art. Echo had established the capabilities of a passive satellite, and, assuming equally favourable results following the experimental launching of a simple active type, "a practical and economical communications system making use of many low-altitude satellites in random orbit need not be many years distant. This is what we are now working toward at the Bell Laboratories."

In *The Synchronous Communication Satellite*, Mr R. P. Haviland of the General Electric Company's Missile and Space Vehicle Department stated that the synchronous satellite appeared to be less desirable than lower-altitude satellites for a telephone or telegraph relay service, but appeared to be superior for direct world-wide television and radio transmission.

The importance of reliability was emphasized by Mr Smelt in his account of Lockheed work and thinking on satellite systems. A reliability of some 50 per cent had been obtained in the first three or four Discoverer launches; this had increased to 60 per cent over the first ten; and in the last few firings in the series the percentage of successes had risen to 80. Concerning the possible types of communications satellites, the Lockheed company had reached the conclusion that, were it not for the reliability problem, the synchronous satellite would be preferable.

Tracking was an important and difficult part of any satellite system, Mr Smelt emphasized. It was bad enough coping with three or four satellites at the same time, let alone the 50 which had been mentioned by another speaker at the symposium. "We have often lost these satellites for seven or eight orbits," the speaker added. "We had to go back and put more terms in the equations."

ROLLS-ROYCE SPEY



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THE NATIONAL GLIDING CHAMPIONSHIPS

Williamson Maintains Early Lead

BY KENNETH OWEN

"FLIGHT" PHOTOGRAPHS

Elliotts Type 460 over Lasham during the championships

SERGEANT John Williamson of the Royal Air Force, flying an Elliotts Olympia 419X sailplane, maintained the leading position throughout the first half of the ten-day National Gliding Championships at Lasham. After the first weekend's flying, reported in last week's issue, the overall points totals of the leaders on the morning of Monday, May 15, were as follows:—

		Points
League 1.	1. J. Williamson (Olympia 419X)	1,047
	2. R. Mann (Skylark 3F)	1,000
	3. J. D. Jones (Skylark 3F)	869
	4. A. Deane-Drummond (Olympia 419)	795
	5. E. Stark (Skylark 3F)	739

with P. G. Burgess leading the standard-class entries in his Ka-6, G. Coatesworth (Olympia 401X) second and A. Gough (Elliotts 460) third.

		Points
League 2.	1. D. Kerridge (Skylark 3F)	600
	2. M. Bacon (Olympia 2B)	359
	3. T. Ware (Skylark 3F)	240
	4. P. Minton (Eagle)	128
	5. J. Chandler (Olympia 2B)	117

Separate tasks were set for the two leagues at Monday's briefing. League 1 pilots were to race to Dunkeswell, Devon, a distance of 98.2 miles, while free distance was specified for League 2. The biggest surprise on this day was that the weather experienced by pilots *en route* seemed to bear little relation to that forecast at briefing. The fact that this *was* a surprise was a tribute, albeit an ironic one, to the extremely high standard of weather interpretation which the gliding fraternity has come to expect as normal from meteorologists Wallington and Findlater.

This discrepancy was explained later by Jock Findlater as follows. With an inversion at 3,500ft, it was expected that the strato-cumulus layer would burn-off soon and that dry thermals would be the order of the day. What actually happened was that the strato-cumulus did thin out, but did not disperse; the Sun warmed the ground and produced thermals, whose attendant cumulus rose into the strato-cumulus layer and thickened it again. Thus pilots were flying beneath a near-solid cloud layer—and experiencing surprisingly good convection in this situation—instead of in the blue sky which had been forecast. Three times during the day Findlater went up in a Chipmunk to see what was going on, and each time was impressed by the shallowness (300ft only) of the layer. As the afternoon went on smoke and haze were trapped beneath it, but the thermals kept on working.

In the race to Dunkeswell the course was completed by ten pilots, with Deane-Drummond reaching the airfield but landing short of the finishing line. The best speed for the course was 42.6 m.p.h., set up by A. J. "Rocky" Stone in a Skylark 3F. Chuck Bentson, also in a Skylark 3F, was second at 38 m.p.h., and the remaining pilots to finish were Peter Scott (Olympia 419X), John Williamson (Olympia 419X), George Burton (Skylark 3B), Mick Kaye (Eagle), Philip Wills (Skylark 3F), Ronald Dunn (Elliotts 460), Joe Croshaw (Skylark 3F) and Mrs Anne Burns (Skylark 3B).

As for League 2, Sgt K. V. Newholme of the RAF in a cooking Olympia 2B had reached Exeter Airport a distance of 109 miles, in the day's best flight. Three other Olympia 2s (flown respectively by Carr, Findon and Aldridge) came second, third and fourth, with Mike Russell in the veteran Petrel (88 miles to Chard) placed equal fourth with Aldridge.

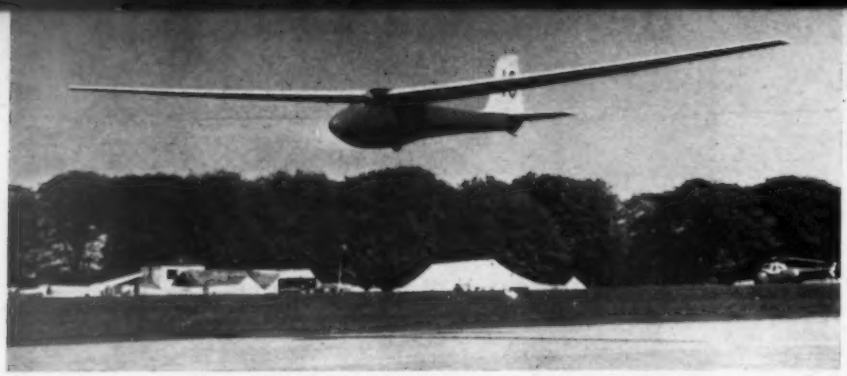
League 1 had now completed three contest days and League 2 had completed two. The leading positions were:—

		Points
League 1.	1. J. Williamson (Olympia 419X)	1,971
	2. A. Deane-Drummond (Olympia 419)	1,595
	3. G. Burton (Skylark 3B)	1,555
	4. R. Mann (Skylark 3F)	1,488
	5. P. Wills (Skylark 3F)	1,428

with Burgess leading the standard-class entries in his Ka-6, Dunn (Elliotts 460) second and the Surrey Club entry of H. P. Hilditch and C. Wills (Skylark 2B) third.

		Points
League 2.	1. Kerridge and Purnell (Skylark 3F)	1,237
	2. Chandler and Newholme (Olympia 2B)	1,117
	3. Bacon and Clarke (Olympia 2B)	1,004
	4. Carr and Greenway (Olympia 2B)	818
	5. Fielden and Berriman (Skylark 3)	796

A familiar sight each day, as sailplanes are pulled up to the launch point prior to aerotow take-off along the runway



Peter Scott's Olympia 419X, entered in League 1 of the championships

NATIONAL GLIDING CHAMPIONSHIPS . . .

Dry remarks on dry thermals were accepted in good humour at briefing on **Tuesday, May 16**, by met-man Wallington, who then went on to give another forecast which proved to be almost equally wide of the mark. A high-pressure area was on its way down from the north; there was rather a lot of strato-cumulus about, but there should be some holes in it; winds would average 060/18kt, and the main problem in flights to the west would probably be "to hold back and to keep up" and not to enter the cloud area. The route cross-section forecast—"It's hardly worth showing you, actually"—showed weak thermals with convection up to 3,500ft.

With these conditions in mind the day's task had been set as distance along a line through Perranporth, Cornwall, for League 1; and a race to Old Sarum, 33 miles away to the west, for League 2. As if the weather itself were not sufficient hazard, Ann Welch gave a further caution, concerning the visit that day of Mr Geoffrey Rippon. "The Parliamentary Secretary's helicopter will be a Sycamore and the blades are at waist level"—not accurate, perhaps, but effective.

Conditions at Lasham improved steadily throughout the day, and an indication that the route forecast also might conceivably have been pessimistic came shortly after 4 p.m. with the news that John Williamson had landed, not at Perranporth, but at Land's End, which was south of the set line but sufficiently further west to make it worthwhile on points. But was this just John Willie's punditry which had triumphed over impossible odds? No, it was not. By 5.30 the pins on the control-room map showed that 14 pilots had landed at Perranporth and six had continued further west, landing north of Williamson near Pendeen. This was clearly going to be one of those days.

This, in fact, turned out to be *the* day. Never in British gliding had so many flown so far on one day. The total at Perranporth Aerodrome that evening was 29 sailplanes, and it would have been a round 30 had not Joe Croshaw come down in his Skylark 3F just two miles short. Among those who landed at the aerodrome after the 191-mile flight from Lasham were Adamek of Poland in his British Skylark 2; Doughty of Britain in his Polish Jaskolka; Burgess and Tiede in the two Ka-6s; and Corbett and Kaye, each in an Eagle two-seater.

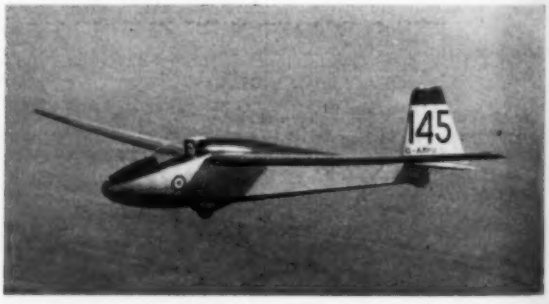
Some pilots had in fact made the mistake of reading the day's "line through Perranporth" task as "line *to* Perranporth" and, arriving over the aerodrome with several thousand feet to spare, had killed their height and landed. This was the classic error made by many pilots on one occasion during the 1956 World Gliding Championships at St Yan, when the majority had landed at Cuers, leaving only the methodical American Paul MacReady to continue his final glide to the coast, landing after dark at the French naval air base at Hyères, where the runway lights happened to be on. The day's 1,000 pts went to MacReady.

Among those present at St Yan five years ago was Philip Wills, who now perhaps spared a thought for the lesson of MacReady as he overflew Perranporth, steamed on down the north coast of the Cornish peninsula, past Portreath and St Ives, and descended in his Skylark on one of the three available fields belonging to the astonished proprietor of Prewellard Farm, Pendeen. In one of the other two fields was a blue-and-white Olympia 419—Peter Scott had already arrived. And, although the farmer did not know it, George Burton and Brennig James were also due to drop in any minute. Tony Deane-Drummond was not far away, relieving the boredom of one lighthouse keeper's day by landing his 419 within half-a-mile of Pendeen Point lighthouse.

For those who overflew Perranporth, the choice of landing place involved the mental balancing of the gain of distance (projected on to the set line) against the diversion from the line. For the day's most accurate balancing, pilots Burton, James, Scott, Wills and Deane-Drummond received 1,000 pts apiece. Between this and the 892 pts for those at Perranporth lay Williamson at St Just Aerodrome, Piggott at Zennor, Mann at St Ives ("by the Atlantic Hotel" ran the landing report), Rocky Stone at Godrevy Headland and Mrs Burns and Hugh Mettam at Portreath Aerodrome.

It was a superb day for the trip to Cornwall. Meanwhile, League 2 pilots were fairly buzzing along the groove to Old Sarum, being whipped back smartly to Lasham by their retrieving crews, and taking off again for further attempts to whittle-down their times for the 33-mile race. Best time for the course was an incredible 24min by Berriman in a Skylark 3, corresponding to an average speed of no less than 83.4 m.p.h. Second place went to Loveland in the Elliotts 460, who made 70 m.p.h.

Launch-point scene, with Chuck Bentson (Skylark 3F) in foreground



New at the contest: third prototype Elliotts Type 460 (pilot Gough)

Because of the League 2 handicapping system, the placings from third down were not directly related to speeds achieved. In third place with 61 m.p.h., for example, was Flt Lt Bacon in an Olympia 2B, although the speed achieved by David Kerridge in a Skylark 3F, who came fourth, was 63 m.p.h. Bernard Davey in an Eagle two-seater was fifth at 57 m.p.h.

The handicapping system gave the following points bonuses: 10 per cent for a two-seater; 10 per cent for a side-by-side two-seater; 20 per cent for a strutted type; 10 per cent for a pre-1950 design, and 10 per cent for a span not greater than 15 metres (or 16 metres in the case of pre-1950 types). The main effect of these provisions was to give pilots of, for example, Olympia 2Bs and Eagles a more-or-less equal chance with those flying the higher-performance Skylark 3s.

John Williamson was still in the lead on overall points in League 1. Current totals were now:—

		Points
League 1.	1. J. Williamson (Olympia 419X)	2,983
	2. A. Deane-Drummond (Olympia 419)	2,595
	3. G. Burton (Skylark 3F)	2,555
	4. R. Mann (Skylark 3F)	2,448
	5. P. Wills (Skylark 3F)	2,428

In the standard-class category, the leaders were P. G. Burgess (Ka-6), H. P. Hilditch and C. Wills (Skylark 2B) and G. Coatesworth (Olympia 401X).

Skylark 3F flown by Don Snodgrass in League 1

telephoned in to report that he had reached St Just—his declared goal. Five had reached Perranporth, and there were six more just a few miles short.

Among the crowd in the control room who were watching the progress of the League 2 pilots were quite a number of the League 1 competitors, 13 of whom had completed the Wantage race earlier in the afternoon. Several others, including Dunn, Piggott, Stone and Kahn, had landed just short of Lasham. Stone took off for a second attempt but found the air quite dead and landed back at the aerodrome. Burgess in his Ka-6 landed late (5.30 p.m.) at Lasham after finding difficulty in locating the turning point at Wantage and taking 3hr 32min for the trip. Several powerful cu-nims had provided spectacular lift during the day, but there had been graveyard areas of sink over the rain-soaked ground in between.

The best League 1 times for the race were set up by Cretney (Skylark 3B), 1hr 40min 55sec; Williamson (Olympia 419), 1hr 41min 16sec; Scott (Olympia 419), 1hr 53min 10sec; and Philip Wills, 1hr 54min 9sec. Corresponding speeds were 37.4, 37.3, 33.3 and 33.1 m.p.h. A total of 16 pilots completed the race.

In League 2, the day's winner was D. W. Stowe (Skylark 2) who flew 216.3 miles to St Just Aerodrome, Land's End. Alexander had obviously stretched his glide to the far side of the same aerodrome, and was credited with 217.7 miles, but his higher-performance Skylark 3F was handicapped into fourth place. Clarke (Olympia 2B) was second with 191.2 miles to Perranporth, Hunt (Olympia 2B) was third with 187.8 miles, and Davey (Eagle) was fifth with 198.3 miles to Portreath.

After five contest days for League 1 and four for League 2, the leading pilots in the championships were now:—

		Points
League 1.	1. J. Williamson (Olympia 419X)	3,980
	2. G. Burton (Skylark 3F)	3,375
	3. P. Wills (Skylark 3F)	3,358
	4. A. Deane-Drummond (Olympia 419)	3,260
	5. P. Scott (Olympia 419X)	3,123

Standard-class leader was still Burgess in his Ka-6, with Hilditch and Wills (Skylark 2B) second and Dunn (Elliotts 460) third.

League 2.	1. Bacon and Clarke (Olympia 2B)	2,765
	2. Kerridge and Purnell (Skylark 3F)	2,726
	3. Chandler and Newholme (Olympia 2B)	2,580
	4. Carr and Greenway (Olympia 2B)	2,327
	5. A. Loveland (Elliotts 460)	2,221

At this point, midway through the championships, there was no doubt that the 32-year-old RAF sergeant who was heading League 1 deserved every point of his lead. Consistently good flying had brought him within the top four places on four of the five contest days—and on the remaining day he came sixth (with 992 points) when the five above him were placed equal first with 1,000 points. Other young pilots—Rocky Stone (28), George Burton (30), J. D. Jones (32), Flt Lt Cretney (33) and Roger Mann (34)—were also moving in high places.

The name of Perranporth was becoming quite well known by this stage of the championships. On **Thursday, May 18**, the name cropped up again, as the finishing point for the 191-mile race specified as the day's task for pilots in League 1. League 2 pilots had to fly about half as far in the same general direction, for their task was a 98-mile race to Dunkeswell. Before take-off the League 2 goal was changed to Nympsfield.

(*To be concluded*)

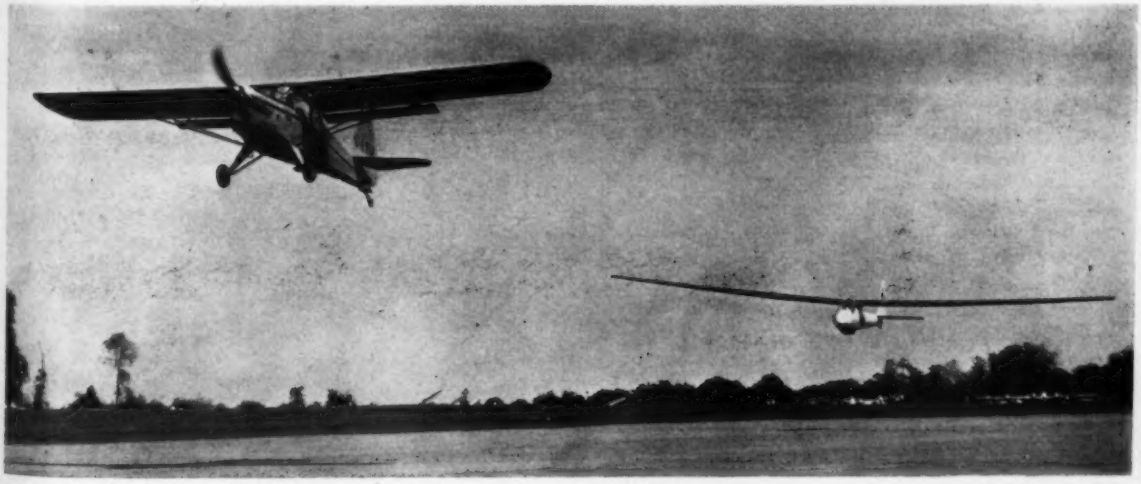
		Points
League 2.	1. Kerridge and Purnell (Skylark 3F)	1,933
	2. Bacon and Clarke (Olympia 2B)	1,812
	3. Fielden and Berriman (Skylark 3)	1,796
	4. Chandler and Newholme (Olympia 2B)	1,712
	5. Carr and Greenway (Olympia 2B)	1,452

"If we'd had an inkling of this we'd have had League 2 all getting their Gold Cs"—this comment had come from chief task-setter Ann Welch as the Cornwall landing reports were coming in on Tuesday evening. On **Wednesday, May 17**, we had the inkling, and League 2 pilots had the opportunity. Free distance was the task for the day, announced at the League 2 briefing at 9 a.m. Winds were north-easterly and forecast conditions were strong.

From the tip of Cornwall to Lasham in Hampshire is a fair journey by road, and the League 1 long-distance men had been arriving back at 5, 6 and 7 a.m. After a few hours' sleep pilots were in the briefing tent again at 11.30, where they presumably would not have been too disappointed to be told of a rest day. But the indomitable task-setters (or taskmasters?) thought otherwise. For League 1 also there would be a task, but it would be a civilized one—an out-and-return race to Wantage, a total distance of 63 miles.

By mid-afternoon it was clear that League 2 were working their way down across Devon and into Cornwall. The route was marked on the control-room map by the pins of those who today would not make Perranporth. By 5.15 the best flight was that of Bernard Davey (Eagle) to Portreath, and it was shortly after that that we heard news of Lionel Alexander (Skylark 3F), who delightedly

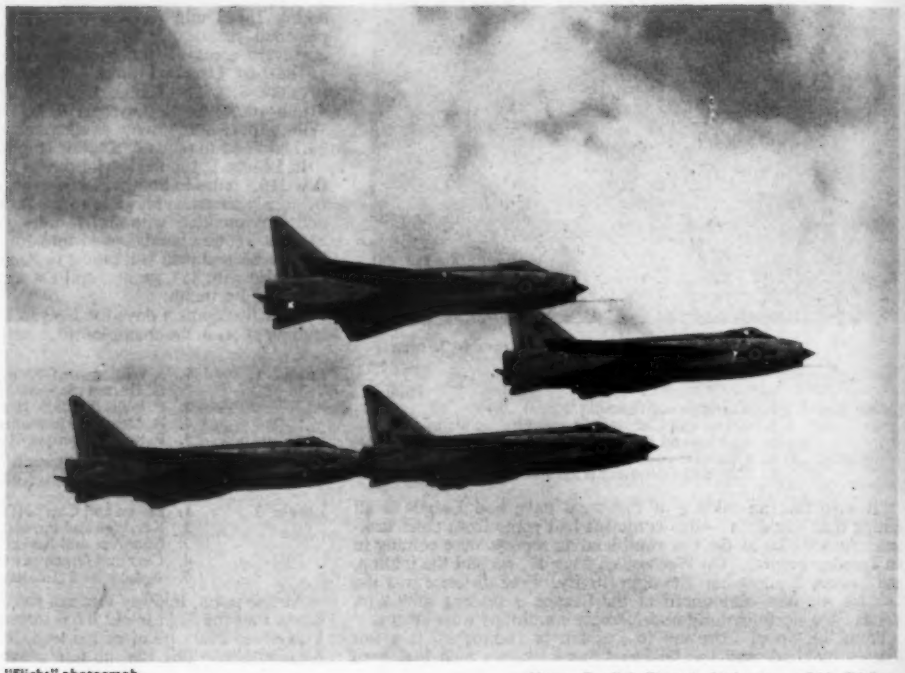
Skylark 3F flown by Bill Tonkyn gets airborne with the help of an Auster 6A tug aircraft. Normal take-off interval was 90sec



PARIS SHOW

Showing the Flag

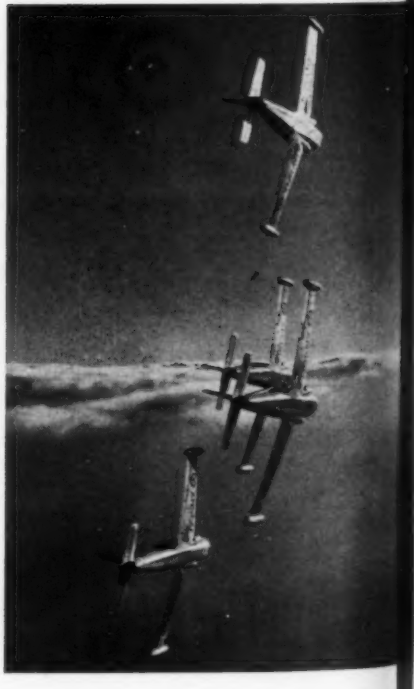
British participation in the 24th Paris Salon



"Flight" photograph

Above, English Electric Lightnings of No 74 Sqn, RAF. Below, Hunting Jet Provosts of the Central Flying School. Both units will be demonstrated

THE merest glance over the following pages is sufficient assurance that Britain's representation at the 24th Paris Aeronautical Salon is an impressive one. Even so, as these same pages closed for press, complete information had not been received in addition to the contribution made by the industry, all three of Britain's Armed Services will take part. The Royal Navy will have an aerobatic team of No 800 Sqn, flying Supermarine Scimitar single-seat twin-jet strike fighters, and the Army will send an English Electric Thunderbird battery of No 36 (GW) Regiment, Royal Artillery, in addition to the team which will man the new English Electric Blue Water surface-to-surface guided weapon. Air drill by English Electric Lightning single-seat all-weather fighters of No 74 Sqn, RAF, will be supplemented by the Central Flying School's aerobatic team of four Hunting Jet Provost trainers; three Handley Page Victor four-jet V-bombers; and an Avro Vulcan B.2 four-jet V-bomber. On static display will be a Gloster Javelin F(AW) Mk 9 two-seat all-weather fighter carrying four de Havilland Propellers Firestreak air-to-air missiles; a Victor; a Vulcan; and a Bristol Britannia troop/freight/ambulance turboprop transport.



Right, Beagle-Auster Airedale

Below, English Electric Blue Water weapon system

AEI (Stand C.138) The main exhibits by Associated Electrical Industries Ltd, as part of the Scintex display, will consists of two diagrammatic layouts showing on the one hand the principal components of a constant-speed 400-cycle a.c. power system, and on the other the principal components of a variable-speed a.c./d.c. power system. In each case a single power-channel will be exhibited and individual components will appear in section, or be fitted with Perspex covers, in order to show details of the construction.

Also on view will be a selection from the range of other AEI aircraft equipment, including high-energy ignition units, aircraft switches, motors and associated items. An instrument which has met with considerable success and which will be exhibited is the AEI electronic ignition tester. This has been designed for use on large piston engines, and incorporates the results of many years' experience in aero-engine ignition testing and research.

Auster (Stand C.252) A Beagle-Auster Airedale (picture above) will be on static exhibition, and a display on the indoor stand will depict the main features of the aircraft.

Avica On the stand of Société A.B.G (B.117) Avica Equipment Ltd will show (1) The Type "W" range of metallic flexibles tested to Spec DTD (RDI) 3955, embodying welded-on couplings (licensee in France, Société A.B.G.). (2) Lightweight high-temperature vee-flange coupling for aircraft fuel and hot-air systems. (3) Gimbal-type flexible joints for air ducting systems. (4) H.T. and L.T. harnesses and wiring conduit assemblies (licensee in France, Société A.B.G.). (5) Support clips in a range of types, including the all-stainless-steel, cushioned design for high-temperature zones. (6) Lightweight flexible ductwork in reinforced Silastic rubber, including moulded laminate sections.

Bell's Asbestos (Stand C.256) The exhibits will include many improved versions of established products which incorporate recently introduced synthetic materials, such as Viton A and B, p.t.f.e., etc. Products worthy of special mention include fire-seals with improved silicone sponge cores and asbestos fabric covers proofed with Viton A to satisfy recent demands for increased temperature and Skydrol resistance; seals with stainless steel wire-mesh cores; garter spring seals of improved design and incorporating new materials and finishes; silicone and glass fabric connecting sleeves; flexible hoses; Bestobell collapsible air-starting hose; Bestobell segment vee-band clamps; a range of asbestos, glass, Terylene and other fabrics; and silicone rubber products.

Bristol Aerojet (Stand A.28) Probably the most interesting Bristol Aerojet exhibit will be a full-scale model of one of the high-altitude meteorological research rockets that the company is developing. There are, in fact, two forms of the rocket, one with a steel body and the other with a glass-fibre plastic body. In addition, Bristol Aerojet are exhibiting a variety of the thin-walled helically welded tubes that they manufacture in steel, titanium and even more exotic metals.

A representative selection of the wide range of lightweight high-pressure gas-storage vessels is being shown, together with such items as rocket nose-cones, expansion nozzles and similar components representative of sophisticated plastic structures.

Bristol Siddeley (Stand A.17) Exhibits will include the Pegasus (BS.53) lift/thrust ducted fan engine; the Olympus, Orpheus and Viper turbojets; the Proteus turboprop; and the Stentor and Gamma rocket engines. A ramjet engine will also be on display.

Selected for the Hawker P.1127 VTOL strike fighter, the Pegasus has an exceptionally high take-off thrust in relation to its cruising thrust and the specific fuel consumption at cruising thrust is low. A most revolutionary feature is the use of movable jet nozzles by means of which the whole of the thrust can be directed downward for lift, backward for thrust, forward for braking flight, or in any intermediate direction. This makes possible the design of both single- and multi-engined VTOL aircraft in which all the engines are of the same type and the whole installed thrust is available for vertical take-off.

A turbojet in the highest thrust class, the Olympus combines light weight with low fuel consumption. It powers all types of Avro Vulcan. Olympus engines have been specified for the British Aircraft Corporation's TSR-2 tactical strike/reconnaissance aircraft.

The current production version is the Olympus Mk 201 of 17,000lb thrust, while the latest version of the engine to go into production will be the Mk 301, which develops 20,000lb thrust without reheat. With Bristol Siddeley Solar fully variable reheat, an advanced version of the Olympus has a maximum thrust in the order of 33,000lb.

The Orpheus 803 is in production for the Fiat G-91 NATO strike fighter and its trainer and reconnaissance variants. This version has a thrust of 5,000lb.

With a thrust of 2,500lb, the Viper ASV 11 has been developed from the earlier ASV 3, ASV 5 and ASV 8 engines fitted to the Jindivik target drone, and for the Hunting Jet Provost, which is in quantity production for the Royal Air Force and the Royal Ceylon Air Force. The Viper 11 powers the Macchi MB 326 trainer.

The Proteus turboprop will be represented at the show by a 705 version of the engine (power unit of the Britannia 102 in service with BOAC) which will be put on show after the completion of its full run of 2,400 hours between overhauls.

The Gamma is a liquid-propellant rocket engine having four trunnion-mounted combustion chambers which swivel under hydraulic actuator control to provide vehicle guidance. The propellants are high-test peroxide and kerosine. The Gamma powers the Saunders-Roe Black Knight re-entry research vehicle. To date, nine successful launchings of this vehicle have been completed.

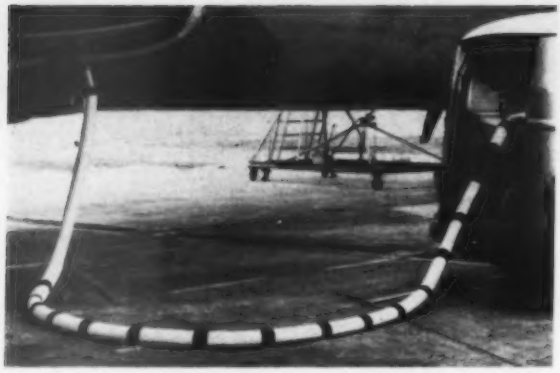
The Stentor rocket engine, which is in quantity production at Bristol Siddeley's Coventry factories, powers the Avro Blue Steel missile.

No details are yet available of the Bristol Siddeley ramjet to be shown in the guided-weapons park.

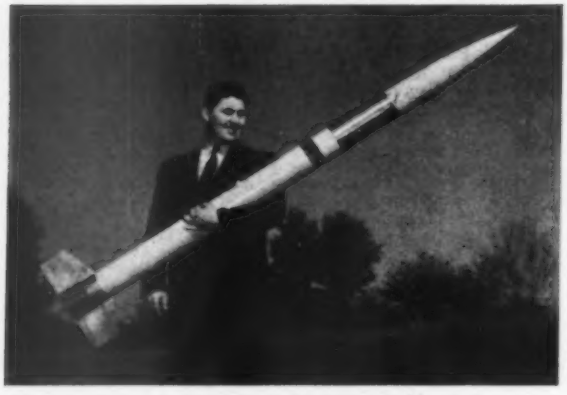
British Aircraft Corporation (Stand A.18) English Electric Aviation Ltd, a member of the British Aircraft Corporation Ltd, will be showing for the first time in public a Blue Water surface-to-surface tactical guided weapon system. This is under development for the British Army. Blue Water meets the NATO requirements for a replacement for the American Corporal and has full cross-country mobility. It can be carried in the Argosy military transport. A Blue Water missile, launcher and computer vehicle will be on outdoor display in the guided weapons park, and the indoor stand will feature a panoramic presentation of the weapon in action. Alongside Blue Water in the outdoor park will be a battery of four Thunderbird anti-aircraft missiles, which will be demonstrated as mentioned on the previous page. Nearby will be the Royal Air Force's Bristol Bloodhound—an anti-aircraft weapon adopted for the defence of Britain's V-bomber bases and chosen also by Australia and Sweden. A Vickers Vigilant, a one-man-portable infantry anti-tank missile which has acquitted itself well in recent British Army trials, will also be displayed in the guided weapons park. It will be shown mounted on a Ferret scout car.

A central feature of the Corporation's stand will present details of the BAC-111 ("One-Eleven") short-haul jet airliner, powered by two rear-mounted Rolls-Royce Spey turbofans. Models will illustrate the roomy fuselage (124in at elbow level) and some possible layouts, including a 69-seat configuration for tourist services. The claim that the One-Eleven is "the jet successor to the Viscount but with even better than Viscount economics" will be substantiated, the makers say, by the exhibition of key performance and economic graphs.

A special display will illustrate the all-round strength and experience of the Corporation. On the civil side there will be models of the rear-engined VC10 and Super VC10 jet airliners, now in production at Weybridge, plus the Britannia, Vanguard and Viscount turboprop airliners. The military aircraft background of the group will be exemplified by models of the Canberra, Scimitar, Jet Provost, Valiant and Lightning, the latter leading logically to the T.188 all-steel experimental aircraft soon to fly and intended for research into the skin-heating problems at high-supersonic speeds. No details will, however, be revealed of the BAC supersonic transport project, nor of the TSR.2 supersonic strike reconnaissance aircraft.



"Bestobell" collapsible air-starter hose



Full-scale model of Bristol Aerojet meteorological research rocket

SHOWING THE FLAG . . .

British Oxygen (Stand B.119) Aircraft breathing equipment, ranging from a 25-litre liquid-oxygen converter package unit to a new portable oxygen-breathing system for light aeroplanes, will be shown for the first time by British Oxygen Aro Equipment Ltd. The stand will also feature equipment made by Aro/Firewel, the American associates of BOAE.

The 25-litre converter being shown was developed for the AWA Argosy C.1, the Short Belfast, and DH Comet 4C and is adaptable for other aircraft. It weighs 110lb when full—a quarter the weight of its gaseous counterpart—and takes up only a quarter of the space. It is 21in wide and 19in high, and holds the equivalent of 22,000 litres of gaseous oxygen at n.t.p. Maximum loss-rate through evaporation is stated to be less than 6 per cent in 24hr. Other converters being shown for the first time in Paris are a 10-litre model, which weighs 41½lb full, and a 3½-litre unit (17½lb full). Both were developed for aircraft currently in use by the Royal Navy and the RAF.

A new portable oxygen-breathing system, the "Harlow" Mk 2, weighs only 25lb and provides sufficient oxygen for four persons in an aircraft cruising at 15,000ft for 2½hr. It consists of a 750-litre oxygen storage cylinder, regulator, high-pressure charging valve, contents gauge and "L" type masks. The only control is the on-off valve mounted on the storage cylinder. This is turned on at the start of a flight and oxygen is then obtained simply by inserting one or more of the mask leads into the manifold outlets provided.

The BOAE stand will also include components for liquid-oxygen breathing systems, models of oxygen storage and dispensing equipment and a nitrogen explosion-suppression system.

A 75-litre mobile liquid-oxygen dispenser will be available on the airfield for replenishing the lox converters of aircraft taking part in the show.

CIBA (Stand C.146) Metal-to-metal bonding with Redux adhesives is the main theme of the CIBA (A.R.L.) stand. The world-wide use of Redux bonding will be illustrated by components from several aircraft, including the Sud Alouette. Aeroweb metal honeycomb core for light-weight aircraft structures will be shown, together with completed sections of control surfaces, floorboards and other components incorporating this type of core. Further information on these CIBA (A.R.L.) products, as well as on the latest Hidux high-temperature adhesives, will be available on the stand.

Decca Navigator This company will be exhibiting—on the C.S.F. stand (B.88)—their Mk 8 and Mk 10 receivers, various Flight Logs and other recent developments. The company's Valetta demonstrator will be at Le Bourget, fitted with a self-setting Flight Log and the Omnitrac hyperbolic to rectilinear computer.

Delaney Gallay (Stand C.148) As typical examples of applications for their high-temperature thermal insulation blankets Delaney Gallay Ltd will be exhibiting a fully insulated thrust reverser, loaned by Rolls-Royce and a heat shroud for the Lightning. This latter, the company's latest development, combines several blankets and a heat shield in an integral unit. A selection of oil coolers in light alloy and stainless steel, including the latest high-density tubular coolers, will also be shown. Exemplifying the anti-icing heat exchangers fitted to such aircraft as the Viscount, Friendship, Herald and Britannia, will be a unit supplied to Vickers for the Vanguard.

As a special point of interest, this year Delaney Gallay are featuring stainless-steel fabrications using argon-arc welding and vacuum brazing techniques.

Dowty (Stand B.121) Dowty Rotol fuel-flow proportioning equipment, which is playing an increasingly important part in modern aircraft, will be prominently displayed. In high-performance aircraft, where fuel forms a large proportion of the all-up weight, it is necessary to have a stable position of the fuel c.g. in order to maintain a stable aircraft c.g. This is achieved by using proportioners, which consist basically of positive displacement metering cells having rotors on a common shaft. It is usual for each proportioner cell to serve one fuel tank, so the sizes of the cells are made proportional to the capacity of the respective tanks served. In addition to metering, Dowty Rotol proportioners are used as in-line booster pumps. Two typical examples from the wide range will be on display. One type of unit is for VTOL aircraft and the other type is for a fighter.

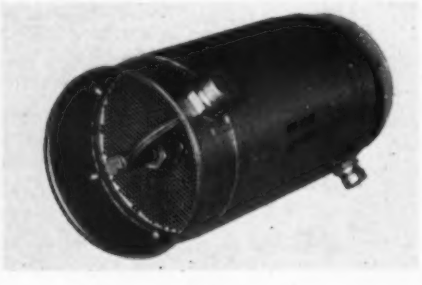
Other items of Dowty Rotol equipment—undercarriages, hydraulics, propellers, gearboxes and engine synchronizers—are extensively installed in the Armstrong Whitworth Argosy and Avro 748, both of which will be at Paris. On the 748 the twin-wheel oleo-pneumatic main undercarriage had to be fitted into the engine nacelles without cutting the basic wing-structure. This was the first undercarriage, incidentally, designed to fit the new Dunlop axle-mounted anti-skid unit.

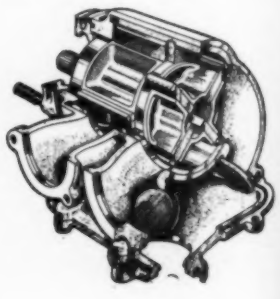
Also on the Dowty stand will be a selection from the range of ram and bleed-air turbines for high-performance aircraft. A ram-air turbine for a jet airliner has a two-bladed, 23in-diameter fan driving a brushless electrical alternator. The fan is air-driven at a nominal 8,000 r.p.m. (±5 per cent) and the maximum alternator output is 20kW.

The Servo Division will exhibit a range of electro-hydraulic servo valves as well as complete packaged flying control units which are based on these valves. In addition the company will have an unusual audio demonstration of a Dowty-Moog valve controlled hydraulic actuator operating at frequencies up to 1,500c/s.

Dowty Fuel Systems Ltd will be displaying a wide range of their latest equipment, including fuel systems for the Bristol Siddeley BS.53;

Left to right, Series 30 Dowty-Moog valve; Delaney Gallay oil cooler for Whirlwind; Dowty-Rotol two-cell fuel-flow proportioner for VTOL aircraft





Last year

BOAC flew

52,000,000 miles

on SHELL

AVIATION FUELS

BOAC is sure of SHELL

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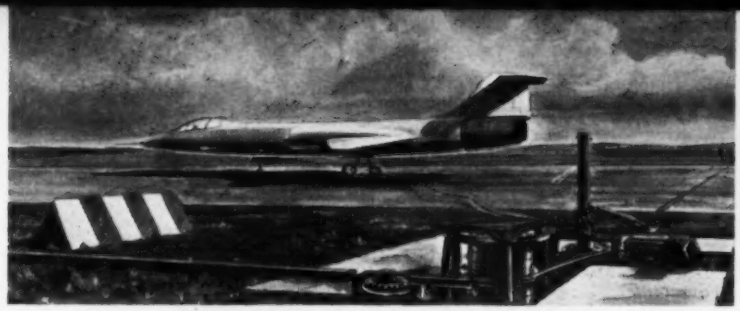
THE MOST ACCURATE FLEXIBLE AND COMPREHENSIVE NAVIGATION SYSTEM FOR THE JET AGE THE DECCA NAVIGATOR

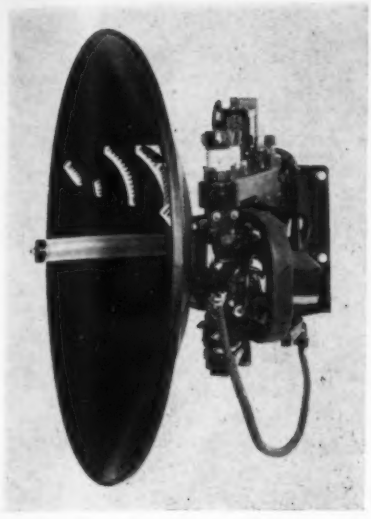
The only system capable of meeting all the navigational requirements of the jet age, the Decca Navigator provides high accuracy coverage over a wide area, regardless of altitude, terrain or climatic conditions. With the pictorial presentation of the Flight Log pilots can see all their required navigational information at a glance. All aircraft can maintain any pre-selected tracks with ease and accuracy and jets can be assigned climb and descent paths that permit them to operate safely and economically.

Over 7,000 ships and aircraft already rely on Decca—using the same system which operates from the ground upwards.

The Decca Navigator Company Ltd London



Artist's impression of Dunlop aircraft arrester gear



Ekco lightweight airborne weather radar Type E190 scanner unit

SHOWING THE FLAG . . .

fuel system components for the Rolls-Royce RB.145 and 153; systems fitted to the Blackburn Artouste; a sectioned system as fitted to the de Havilland Gyron Junior; and individual components including various types of spill nozzles, mechanical governors and a vapour core pump similar to units being used to supply fuel for reheat systems.

Dunlop (Stand A.52B) A variety of aircraft accessory equipment, ranging from de-icing gear to complete tyre, wheel and brake assemblies, will be shown, together with a model of a new ground arrester-gear for which Dunlop are supplying components. There will also be windscreen wipers of two types—the Maxivue and Wylie. De-icing equipment will include units for propeller blades, air intakes and spinners and ground equipment will be represented by mobile charging trolleys, and wheel assemblies. These last will include those for the de Havilland Trident and Dornier Do 28. The Trident wheel, incorporating a Maxaret anti-skid unit and a brake-cooling fan installation, carries two tubeless tyres. Among other items will be a propeller brake and aircraft flexible pipes. A selection of high-temperature pneumatic controls for engines will include a ram for the thrust reverser of the Rolls-Royce Conway; a twin-tandem ram for reheat control (e.g., Bristol Siddeley Olympus); a thrust-reversal selector valve for the Rolls-Royce Avon; and an ant-icer valve for the de Havilland Gnome.

Ekco On the stand of European Air Service, Ekco Electronics Ltd will show their lightweight airborne weather radar Type E190. The scanner unit incorporates a 24in antenna with switchable pencil/cosec² beam distribution. Line-of-sight stabilization is used with a velocity-corrected servo system which maintains stabilization accuracy throughout the 180° sector scan. The indicator unit conforms to ARINC standard dimensions and includes all operational controls. A 5in × 3in rectangular tube, operating at 18kV, displays the full range throughout the 180° azimuth sweep. The high operating voltage, together with an angled polaroid filter, ensures exceptional display visibility even under bright ambient light conditions. Either single or dual indicator installations can be provided. The transmitter/receiver unit employs the latest microwave receiver technique, including a ferrite load isolator.

Also on view will be Ekco automatic VHF direction finding equipment Type CE178.

Fairey (Stand C.172) The Fairey stand will combine the displays of three companies of the Fairey Group—Fairey Engineering Ltd, Fairey Air Surveys Ltd, and Siebe, Gorman & Co Ltd. Each will occupy one or more sections of the Group stand and Avions Fairey SA, the Belgian subsidiary, will be exhibiting separately. On the Fairey stand a new British Army launcher vehicle for the Malkara anti-tank guided weapon will be shown—diagrammatically—for the first time. The vehicle is a self-contained armoured fighting unit, air-transportable, and capable of being dropped into forward areas by parachute. It will carry four Malkara wire-guided missiles of the type now in production for the British Army as its standard anti-tank guided weapon. The Weapon Division of Fairey Engineering Ltd will display a Jindivik Mk 2B pilotless target aircraft on its launching trolley. This has a Bristol Siddeley Viper ASV.8 turbojet, giving a speed in the 600 m.p.h. class and an operational ceiling in excess of 50,000ft. Also shown on stand 172 will be RADOP subsonic and supersonic towed target systems for air-to-air and surface-to-air weapon training. These are distributed exclusively in Great Britain and most of Europe, Africa, the Middle East and British Commonwealth by Fairey Engineering Ltd.

The Hydraulics Division of Fairey Engineering Ltd will show power controls for several different aircraft. A working demonstration will feature a very advanced and compact unit that can perform a number of different functions. It accepts the usual manual input commands from the pilot and is fully duplicated hydraulically. It is also able, the makers say, to meet the demands of an automatic stabilizing computing system, thus smoothing out any tendencies to yawing or pitching. Additionally the unit can control the aircraft completely automatically with the pilot flying hands-off.

Fairey Air Surveys Ltd will show some of the latest of their techniques. These include the use of a new radio-wave distance measuring system known as Aerodist and having three channels which measure distance from three different points on the ground and thus provide a continuous fixation of position. The airborne profile recorder is another new device now being evaluated as a mapping aid, and the Fairey monitor camera is a new and rapid means of finding the exact location of a military target. The Research and Engineering Division is showing some of the results of its study of the problem of aircraft vibration.

Siebe, Gorman & Co Ltd are exhibiting on stand 172 a fire-fighting suit in aluminized asbestos with heat insulating under-suit. This is claimed to allow a rescuer to stay many times longer in the heart of a very high temperature fire than the 50 or so seconds permitted by previous suits. Next to the suit is a self-contained compressed-air-operated circular saw for cutting into crashed aircraft.

Ferranti (Stand C.173) The Ferranti Airpass (airborne interception radar and pilot's attack sight system) will be one of the main items shown. Airpass I which is in squadron service with the English Electric Lightning will be displayed, and Airpass II, which, like its precedessor, is a high-power monopulse radar system, will be shown in pictorial form, since it cannot be spared from its present programme of proving trials. Developed as a private venture, Airpass II provides largely for automatic navigation and weapon-aiming by day or night on interception, ground support or long-range strike missions, yet the size and weight are little more than those of Airpass I, which is purely an interception system. The pilot's attack sight is identical in both instances and the Airpass II radar has many features similar to those of Airpass I. An interchangeable nose-pack is retained, thus saving weight and simplifying front-line servicing.

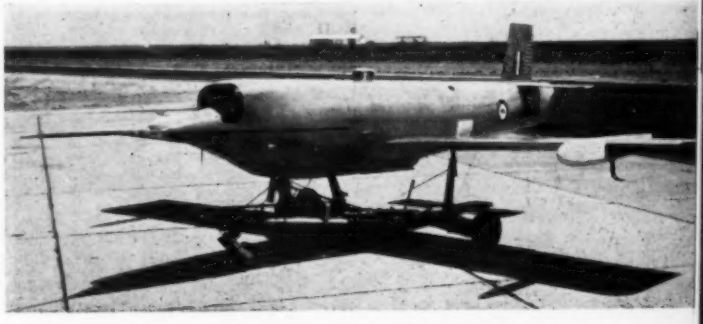
The Ferranti ISIS (integrated strike and interceptor system) family of fire-control systems that will be on view has been designed for light ground-support aircraft, such as the Fiat G.91 or Folland Gnat. In all versions provision is made for aiming guns air-to-air; aiming guns and rockets air-to-surface; and aiming conventional bombs in a dive attack.

Other products of the Scottish group of Ferranti factories which will be displayed include a range of gyroscopes and accelerometers, high-temperature transformers, precision potentiometers, and a low-force multi-unit unitor plug and socket. Another exhibit will be the Ferranti airstream direction detector system, developed in collaboration with Specialties Inc, of New York, to provide the pilot with continuous angle-of-attack information.

Equipment shown by the Aircraft Equipment department will include the T.R.500 transistorized transformer-rectifier unit used in the Vickers Vanguard; the T.R.150 transformer-rectifier unit; vertical-reference gyro; standby artificial horizon (F.H.7 Series); and stand-by directional gyro system.

A wide range of silicon semiconductor devices will also be displayed.

Fairey Jindivik Mk 2B pilotless target aircraft on launching trolley



The Military Argosy (known by the RAF as the Argosy C. Mk 1) will be shown in the colours of Transport Command, who have 56 of these Rolls-Royce Dart-powered rear-loading transports on order. The Avro 748 will be making its first flight overseas in order to attend. Like the Argosy, it is Dart-powered. It has been ordered by Skyways, BKS Air Transport, Aerolineas Argentinas and Aden Airways.

Three versions of the de Havilland Gnome engine will be included —the Gnome H.1000, a 1,050 s.h.p. free turbine for helicopter applications; the 1,000 s.h.p. turboprop Gnome P.1000; and the Coupled Gnome H.1200, which develops 2,500 s.h.p. This last unit is under development for the Westland Wessex Mk 2. Blackburn Engines are

SHOWING THE FLAG...

Above, scale model of Handley Page HP117 project for a 300-seat all-wing laminar-flow airliner

Avro 748 feederliner, powered with two Rolls-Royce Darts

Graviner (Stand C.241) The Graviner Manufacturing Co Ltd will display:

(1) A smoke detector—a compact lightweight unit unaffected by voltage variation and possessing fast response characteristics. (2) Smoke viewer—a miniature unit capable of monitoring up to five compartments. Illumination is by a single source and indication is achieved by Tyndall effect. (3) Hermetically sealed H.S.R.S. detector—a fully sealed unit meeting ARB and FAA requirements; it is capable of rapid operation and resetting within the temperature range of −50°C to +500°C. (4) Hermetically sealed cartridge units—fully sealed units with easily replaceable cartridge charges. (5) Firewire—the standard detector will be shown together with the improved accessories and control units for both a.c. and d.c. There will be a.c. control units for use in ambient temperatures up to 120°C. (6) Extinguishers—filled with Bromotri (13B1) BCF (12B1) and CB; these extinguishers are fitted with a pressure relief device. (7) Pressure-relief indicators—small units for use in conjunction with the above-mentioned extinguishers. These are designed for flush mounting. (8) Hand extinguishers which can be charged with either CB or BCF (12B1) or 1¾lb and 3lb capacity. (9) Heavy-landing indicator—this gives warning of a very heavy landing of the kind which might give rise to incipient structural damage. (10) Explosion protection—the standard equipment for preventing catastrophic aircraft damage caused by fuel-tank explosion.

Handley Page Under the aegis of Royal Air Force Bomber Command a Victor jet bomber will be shown at Le Bourget. The Victor also serves as a photographic and radar reconnaissance aircraft, and a radar map of an area the size of the United States can be made in only one sortie by four Victors.

The Victor will participate in the flying display, as will the Herald feederliner. Now in service with Jersey Airlines, Heralds will also be introduced later this year by Maritime Central Airways and Nordair of Canada. Production is well advanced on the first batch of 25 aircraft at Handley Page's four factories round London. On sales and demonstration tours Heralds have flown 200,000 miles to 58 countries and carried 12,000 passengers. A static exhibit will feature the HP117 project for an all-wing airliner to reduce transatlantic fares by as much as 30 per cent. This aircraft would use Handley Page's laminar-flow techniques (for reducing drag by controlling the air flow) and would, the makers claim, offer the most effective way of bringing air travel to the multitude at low cost. The aircraft would seat 300.

Hawker Siddeley (Stand A.21) In addition to the Armstrong Whitworth AW.660 Military Argosy and the Avro 748 feederliner, Hawker Siddeley will have at Paris a de Havilland Canada Caribou STOL aircraft. In the flying display there will be a Blackburn Buccaneer low-level strike aircraft; a de Havilland Dove 8 and Heron feeder/executive transports; de Havilland Canada Beaver and Otter single-engined STOL aircraft; a Hawker Hunter Two-Seater; Folland Gnat Trainer; Avro Vulcan jet bomber; and—subject to availability—a de Havilland Comet 4B or 4C jet airliner. With examples of three types of missile —the Armstrong Whitworth Seaslug, Avro Blue Steel and de Havilland Firestreak—Hawker Siddeley claim that their contribution will be the largest ever made by a single manufacturer at the Paris Show.

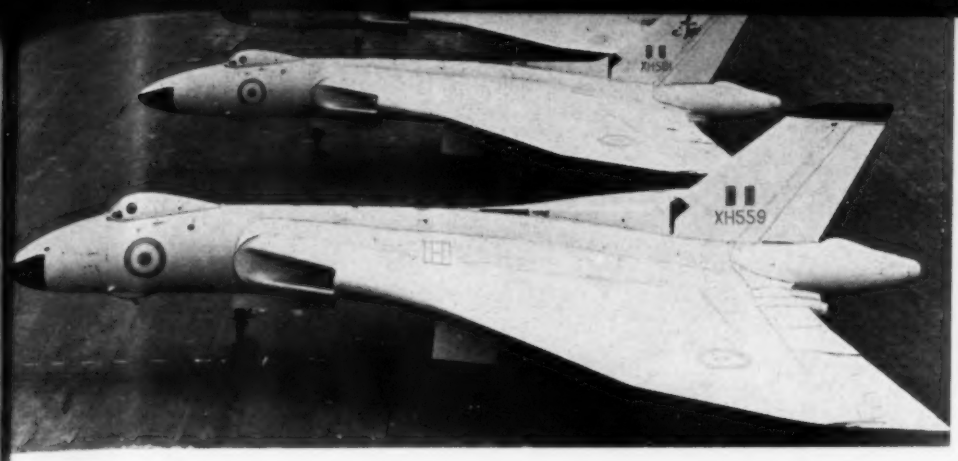
showing a Nimbus (about 1,100 h.p.) in sectioned form, together with an auxiliary power unit and other gas turbine equipment. There will be models of 15 aircraft of many types at present in production by Hawker Siddeley Aviation, and including the truly revolutionary Hawker P.1127 STOL/VTOL strike-reconnaissance aircraft. On the ancillary equipment section of the stand Armstrong Whitworth Equipment will show for the first time a series of refuel/defuel couplings, and there will be other fuel system equipment together with AWE flight deck temperature control system, automatic pitch stabilizing components and a wide range of electronic and hydraulic components suitable for ground-test rigs or control systems. Folland will show a Mk 4 lightweight fully automatic ejection seat. An especially appropriate contribution from de Havilland will be a propeller and spinner assembly for the Breguet Atlantic NATO maritime-reconnaissance aircraft. Other DH items will include a fuel control unit for the Gnome turboshaft engine and transistor inverter, a torque motor, and illustrations of the Acorn check-out equipment. The actual Acorn equipment will be seen on the MATRA stand. In the outdoor exhibition area, adjacent to the missiles, another Hawker Siddeley company, SARO (Anglesey) Ltd, will have a 10,000-gal aircraft Super Fueller in the insignia of Air BP.

A Hawker Siddeley missile exhibit of special interest will be a simple working model to show how beam-riding is achieved with the Armstrong Whitworth Seaslug. In this model a missile will move within a representation of the conical scan of the guidance radar, the movements of the model producing appropriate angular movements of the fins on a full-scale control section of the missile. This demonstration is one of several Seaslug exhibits by the three main contractors on the missile —AWA, GEC and Sperry. Also on view will be two types of Seaslug guidance receiver, the first a prototype used in development firings and the second of the type about to go into production for Seaslugs to arm the first of the Royal Navy's County Class guided missile ships. Printed circuits are extensively used. Additionally there will be a full-scale sectioned missile, functional shipboard control and guidance test equipment, and a range of sectioned components from the Seaslug control section.

High Duty Alloys (Stand B.100) High Duty Alloys Ltd will be showing many of the aluminium alloy forgings which they manufacture for Continental aircraft constructors. Amongst these are components for Hispano Suiza, Fokker, Messier, Fiat, Messerschmitt and Nord Aviation.

The exhibits will include the large undercarriage forgings used in the Caravelle and Friendship. In addition, the display will feature many items produced by the special forging techniques used by High Duty Alloys, such as reverse-flow, split or totally enclosed die. In other years HDA have exhibited forgings in nickel and titanium alloys; this year these materials will again be shown, but in addition there will be steel forgings. Turbine and compressor blades in a wide range of materials will also be featured.

In their aluminium-alloy sheet exhibits, a stretch-formed component in Hiduminium R.R.58 high-temperature aluminium alloy will be shown, together with a spun fairing for the Rolls-Royce Avon engines used in the Caravelle. Among the display of aluminium alloy extruded



Avro Vulcan B.2s, powered with four Bristol Siddeley Olympus

sections there will be examples of those supplied to Fokker and other constructors. In addition to the foregoing, there will be examples of sand- and gravity-die castings.

Hobson (B.85) Items to be displayed by H. M. Hobson Ltd are tandem piston jack Type 194; feel simulator unit Type 385; camber flap control Type 437; flap control unit Type 407; feel simulator units, control Type 438 and jack Type 439; feel simulator control Types 205 and 293; feel simulator jack Types 294 and 192; powered flying control Types 157, 190 and 145; ball type screw jack Type 378; fuel flow proportioner Types 333, 440 and 425; constant speed alternator drive Type 403; ramjet air/fuel ratio control Type 176; tank mounted fuel booster pump and canister, pump Type 436 and canister Type 433; speed governing fuel control unit Type 100; electro-hydraulic actuator Types 214 and 262; carburettor Type A.I.55-J; two stage electro-hydraulic servo; cockpit engine control Type 373 Mk 1; flow control unit Types 212 and 224; acceleration control unit Type 211; twin flap control Type 377; droop control Type 392; hydraulic motor-pump unit Type 215; electric motor-pump unit Type 216; hydraulic power pack Type 275; hydraulic pump Types 180, 181 and 197; hydraulic motor Type 199; motor-pump unit Type T.311; constant pressure pump Type T.384; constant pressure pump Type Y.387; and motor-pump unit Type 293 Mk 2.

Particular interest is likely to be aroused by the feel simulator unit Type 385, designed for the Vickers-Armstrongs VC10. This is a self-contained tri-axis simulator. It provides the pilot with synthetic feel forces proportional to the pitot pressure, with the addition of altitude correction on the pitch and roll axes. The electric motors, pumps, hydro-pneumatic control valves and loading jacks are duplicated in such a way as to maintain the feel unchanged in the event of failure of one half of the system. The hydraulic fluid used in Skydrol. A manually operated trimmer jack is incorporated on the yaw arm.

I.C.I. Metals Division (Stand C.171) The Metals Division of I.C.I. is exhibiting for the first time, and their display will draw attention to the extensive and expanding use of titanium—available in six commercially pure grades and six alloys—in the aircraft industry. The exhibits show how readily various fabrication techniques, such as welding, forging, machining and forming, are applied to the material and its alloys.

I.C.I. Metals Division has for several years carried out an intensive programme of research and development on titanium alloys to meet specific requirements of aircraft designers. Particular attention is devoted to heat-treatable alloys which can be formed in the soft, solution-treated condition and subsequently aged to achieve much higher strengths. Other alloys have good creep-resistance and offer a useful extension to the temperature range in which titanium can be used.

Lodge (Stand B.91) The exhibits of Lodge Plugs Ltd will be sparking plugs, igniters and thermocouples, and Sintox engineering ceramics. The plugs themselves incorporate as insulating material Sintox ceramic, claimed to have a thermal conductivity twenty times that of porcelain; di-electric strength is so little affected by temperature that at 300°C the resistance is about one million times that of porcelain. Under tension, compression and shear stresses Sintox is stated to have at least twice the strength of porcelain.

Lucas (Stand B.76) Among the exhibits on the Lucas stand for Turbine Equipment Ltd items of particular interest are the equi-velocity system (EVS) combustion chamber, the chassis-mounted fuel system (CMFS), the P.750 aircraft hydraulic pump, the hydraulically driven fuel boost pump and quick-release couplings.

The EVS combustion system is designed to provide a uniform exit velocity from the compressor and so provide the ideal temperature traverse at the turbine entry, particularly with regard to annular combustion chambers. The system comprises a series of passages in the compressor exit to re-distribute the flows into the combustion chamber and so equalize pressure and velocity across the combustion chamber area.

The CMFS comprises a complete fuel system *en bloc*, with the exception of flow distributor, dump valve and sprayers. The system is designed primarily for two-shaft turbojet applications and comprises two independently driven high-pressure shaft and low pressure shaft pumps, each fitted with a governor and rate reset, a potentiometric full-range flow control, incorporating altitude-idling control and jetpipe temperature limitation, and an acceleration control with pressure ratio switch. The system is designed to cater for altitudes of 60,000-70,000ft, although for normal running a double-datum governor on the l-p shaft pump enables the pilot to select specific governing speeds for maximum engine speed or for cruising speed.

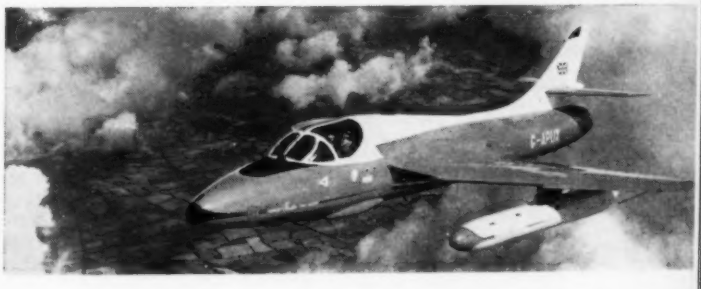
The hydraulically driven fuel boost pump is designed to supply fuel to the engine h-p fuel pumps under all conditions of flight, including fully inverted, and is designed to be fully installed within the tank. The pump comprises a centrifugal main impeller, with two auxiliary impellers so mounted that one intake is at the bottom and the other at the top of the tank. The impellers are driven by an attached hydraulic motor powered by an engine-driven hydraulic pump. The operating fluid between the pump and motor may be either engine fuel or hydraulic fluid tapped from the aircraft hydraulic system.

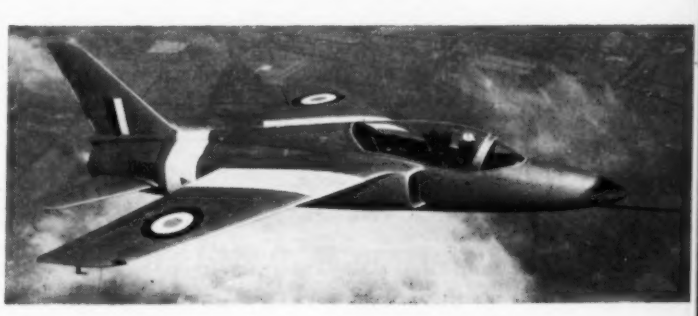
The P.750 pump is capable of operating on all conventional hydraulic fluids and also on modern silicone-based fluids. It will provide a maximum continuous operating pressure of 4,000lb/sq in at 3,000 r.p.m., with a nominal flow rate of 12.5gal/hr.

The quick-release pipe couplings have been designed to provide a push/pull quick-release connection for use in aircraft and rocket hydraulic, fuel, oil, air and gas systems. When connected, the coupling provides free flow of fluid or gas whilst upon separation, the disconnected ends are sealed immediately.

Marconi (Stand A.13) This manufacturer will show for the first time at Paris a selection from their Sixty Series range of airborne communications equipments and navigational aids. Since this series was introduced at the 1960 SBAC Display BOAC have specified the entire range as standard equipment for their fleet of Vickers VC 10s. Airline interest generally is described as "very considerable." The extensive use of transistors, together with subminiature components and new constructional techniques, has effected a great saving in weight over previous equipments.

In addition to their subminiature automatic direction finder, Type AD 722, Marconi will exhibit a basic closed-circuit television camera channel, Type BD 871. Although at first thought, they say, such equipments may seem to have little in common with the aeronautical world this is in fact far from being the case. Already the television camera has





Above, Hawker Hunter Two-seater (Rolls-Royce Avon). Below, Folland Gnat Trainer (Bristol Siddeley Orpheus)

SHOWING THE FLAG . .

Above, de Havilland Canada Caribou (two Pratt & Whitney R-2000 Twin Wasps)

Left, Armstrong Whitworth Argosy C. Mk I with four Rolls-Royce Darts

proved itself a valuable adjunct in a wide variety of applications in this field—for example, as the means of the visual transmission of data in an air traffic control system, or the remote viewing of an otherwise out-of-sight portion of a runway or air park. The prime requirements of such equipment, the makers remark, are that it shall be robust and extremely simple to operate, and that it shall provide a good quality screen picture. These stipulations, they claim, are all met in the BD 871 equipment. Its operation is no more difficult than that of a domestic television receiver, whilst the quality of picture obtainable is such that the camera is suitable for certain broadcasting applications.

Apart from the BD 871 closed-circuit television camera channel, Marconi will be showing VHF communication equipment Type AD 160, comprising a VHF transmitter Type 6400 and VHF receiver Type 6401; VHF navigation and approach guidance equipment Type AD 260, incorporating the VHF receiver Type 6401, plus a navigation unit Type 6402, a marker receiver Type 6403, and a glide slope receiver Type 6404; automatic direction finder Type AD 360, comprising the ADF receiver Type 6407, the quadrantal error corrector Type 6408, the controller Type 6409 and the loop Type 6410; and the AD 722 subminiature automatic direction finder. Of the last the makers say: "It is equally at home in fighter aircraft, private aircraft and helicopters, and is currently attracting much attention as an ADF for passenger and freighter aircraft. The Avro 748 twin turboprop to be built by the Government of India will carry the AD 722—also manufactured in this instance in India under a manufacturing agreement between the Government of India and the Marconi Company. The AD 722 is eminently suitable as a replacement ADF in older aircraft such as the DC-3, in which capacity it effects a valuable weight-saving."

Martin-Baker (Stand A.6) On the stand of the Martin-Baker Co, Ltd, which will form part of the Hispano Suiza group exhibits, will be a Mk AM4 ejection seat manufactured in France by Société des Exploitations des Matériels Martin-Baker, a company formed jointly by Martin-Baker and Hispano Suiza. This British-designed seat is typical of the Mk 4 series lightweight seats in current production for the RAF and Royal Navy and is installed in the Marcel Dassault Mirage of the Armée de l'Air and the Etendard of the Aéronavale.

Also on the stand will be a Martin-Baker Mk H5 seat. Again a fully automatic ejection seat with ground-level capability, it is one of the many seats designed especially for installation in American aircraft and which have been ordered by the US Navy. Two of these seats are installed in the McDonnell F4H Phantom 2, an M2-plus carrier-borne strike/fighter.

Perhaps the most interesting exhibit will be the prototype rocket-assisted ejection seat which Martin-Baker hope to have on display. This rocket seat will have zero-speed/zero-altitude capability and is especially suited to VTOL aircraft. During the flying programme at Le Bourget on June 3 and 4 it is hoped to demonstrate the capabilities of this seat from a ground rig mounted on a lorry and using a dummy subject.

Murphy (Stand 243C) Murphy Radio Ltd, Electronics Division are featuring Autoland aircraft equipment and a transportable radar beacon MR347.

Autoland leader-cable aircraft equipment provides the azimuth guidance signal which is fed to the autopilot when this is being used for automatic landing. This guidance is obtained by comparing the strength of the magnetic fields due to the alternating currents in the leader cables installed on either side of the runway approach path. Using Murphy leader cables, in conjunction with a suitable autopilot and altimeter an aircraft achieves a true blind landing—completely automatic approach and "hands-off" touch-down in conditions of nil visibility.

The Transportable Radar Beacon Type MR347 is a portable transponder beacon suitable for use with any of the current Rebecca type airborne equipments. It has a wide range of applications and can be operated as a mobile installation, either in a vehicle or an aircraft. The equipment is so designed that it can be dropped by parachute and will be drawn from battery/generator sets, or, alternatively, operation can be from batteries alone for a limited period.

Napier (Stand A.13) The principal static exhibit by D. Napier & Son will be scale models of both the Gazelle 501 (used in the Wessex and the Belvedere helicopters) and the Gazelle 512 (developed for helicopters in which all the reduction gearing is incorporated in the aircraft installation and the power is taken direct from the free power-turbine output shaft). A model of a Wessex will be shown, with material samples illustrating the effectiveness of corrosion preventative treatments specially developed by Napier for components of aircraft operating under conditions that are particularly conducive to corrosion. Additionally there will be models of the civil and military versions of the Westland Belvedere, specimens from Napier's investment foundry, a quarter-scale model of the Eland tuboprop and a model of an Allegheny Airlines Convair 540.

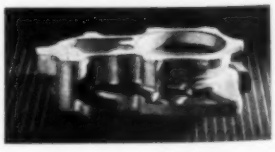
A separate stand featuring the Napier Spraymat ice-protection system will be sponsored jointly by Napier and their Spraymat licensees. The centrepiece will be the engine intake of a Lockheed Starfighter to which Spraymat has been applied. Napier's US licensee, Flight Support, a division of Pacific Airmotive Corporation, currently handles the application of Spraymat to all Starfighter intakes, but the West German licensees, Westfälische Metall Industrie KG, will shortly take on the work for the European Starfighter programme.

Other Spraymat exhibits will include applications to Electra and Gannet components and to helicopter rotor blades. There will also be examples of Sierracote, the transparent film heater used in aircraft windscreens and made by Napier under licence from the Sierracin Corporation of the USA.

Normalair (Stand B.98) Displayed on the Normalair stand will be a wide range of pressurization, air-conditioning and oxygen-breathing equipment, intended to illustrate the scope of the company's activities, and to emphasize the ability of Normalair to design, develop and manufacture complete, integrated cabin-atmosphere control systems for all classes of civil and military aircraft. The centrepiece will be an animated, twice-full-size Perspex model of the cabin air compressor which forms one of the major components of the air-conditioning and pressurization systems being supplied by Normalair for installation in the Weser Nord Transall C.160 military transport. Normalair have been given complete responsibility for the design and development of these systems and have developed the compressor specifically for this application. Fully automatic in operation, it incorporates built-in flow and surge control and a two-speed gearbox.

Other items of particular interest on display will include equipment being supplied for the Vickers VC10. The VC10 pressure-control system is a new Normalair development which obviates the need for long pneumatic pipe-runs within the aircraft by utilizing electric signals to activate pneumatic discharge valves. This method simplifies the problem of obtaining good flow distribution between widely dispersed discharge valves and also provides effective system-control sensitivity.

The equipment is mounted in the aircraft in pack form for simplicity of installation and servicing, and is duplicated for convenience and safety. The basic component is a single-stage centrifugal compressor



End-frame for a feathering pump motor—a split die forging by High Duty Alloys in Hiduminium 66 aluminium alloy

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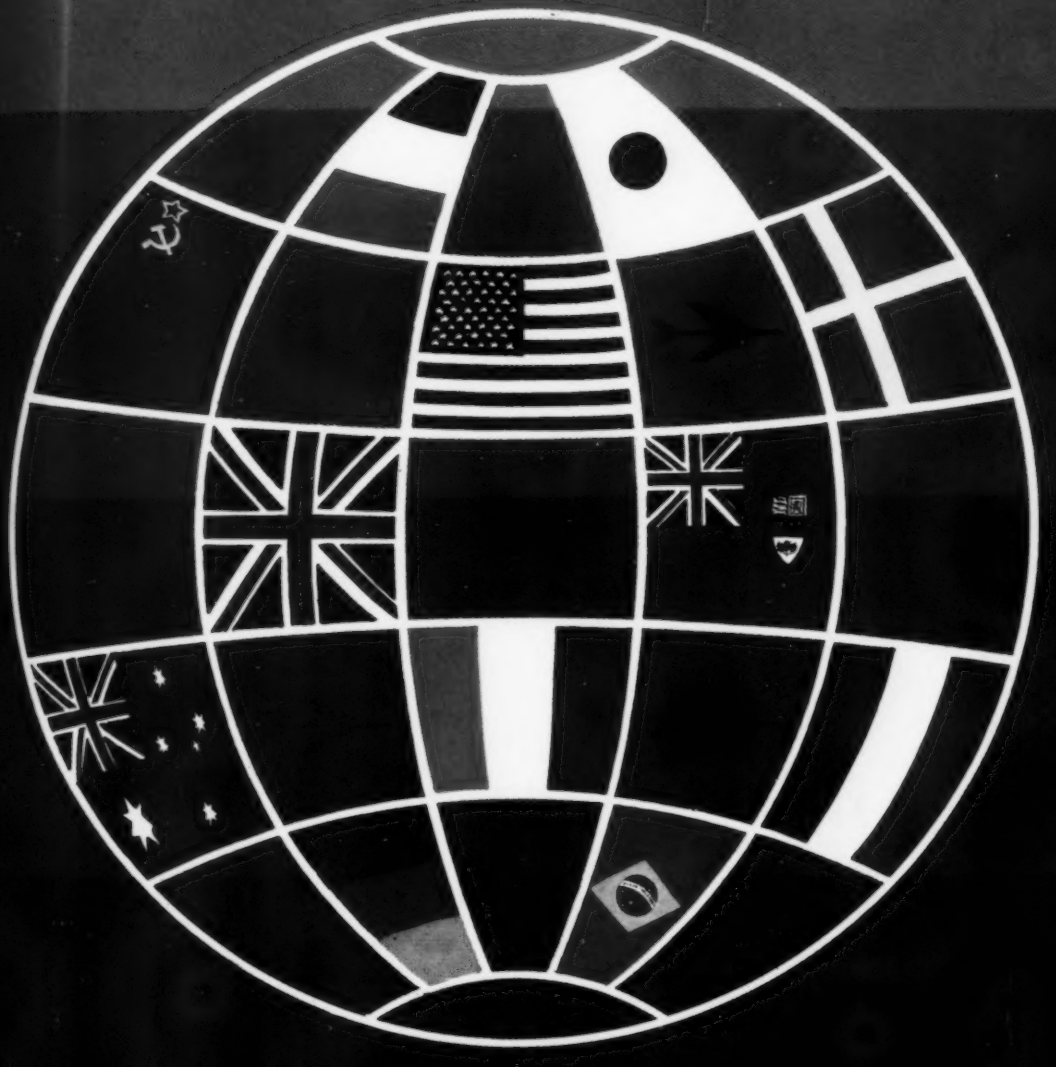

FRANCE: SA Caravelle Breguet 1150 Atlantic Transall C160
SWEDEN: SAAB Lansen SAAB Draken ITALY: Fiat G91T Macchi MB326
GERMANY: BMW engine type 6002 Dornier Do27 & Do28 JAPAN: Namco YS11
HOLLAND: Fokker Friendship USA: Grumman Gulfstream USSR: Rover APU

IN THE FINEST AIRCRAFT

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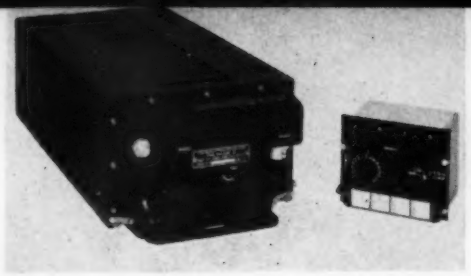
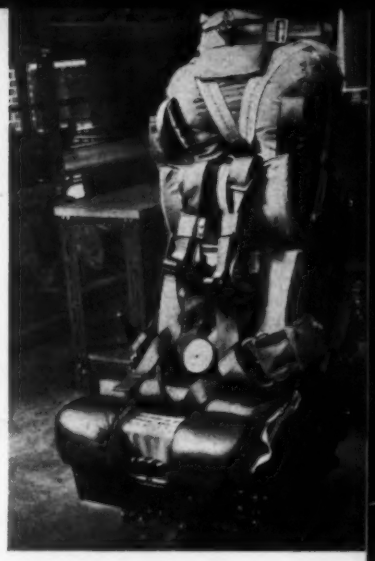




Top left, UHF transmitter/receiver Type AN/ARC.52 manufactured by Plessey under licence from Collins

Top centre, Normalair 30-litre liquid oxygen converter for Vickers-Armstrongs VC10

Right, Martin-Baker AM4 ejector seat

SHOWING THE FLAG . . .

driven by an air turbine, pneumatic power being used for operation and control of the system.

The Vickers VC10 will be the first airliner in the world to be fitted with liquid-oxygen storage equipment. A converter with a capacity of 30 litres will be supplied by Normalair for installation in each aircraft to serve the emergency oxygen system which is being installed to comply with anticipated revisions to the Air Navigation Regulations.

Normalair will be displaying many examples of gaseous and liquid-oxygen systems and equipment, including the latest development of the company's demand oxygen regulator. The seat-mounted oxygen regulator system will also be shown. A further range of Normalair equipment including cold-air units, water extractors, pressure controllers, and temperature control valves will also be displayed on the Breguet-Garrett stand, which will be combined with the display stands of the Garrett Corporation of America and Normalair Ltd to form an integrated display area.

Plessey (Stand C.134) Plessey International Ltd will show an aircraft generation system similar to that which will be installed in the Vickers VC10. The system comprises generator, voltage regulator, control panel and current transformer package, and capacities of up to 120kVA are available. The control equipment is fully transistorized, using printed-circuit sub-unit techniques. Other items on view will include a crew suit temperature controller, a windscreen de-icing controller, sealed and unsealed miniature relays and electro-magnetic indicators.

A new constant speed drive/starter combines in one self-contained unit a precision constant-speed drive and a power drive for ground-running system accessories. It also functions as a starter when supplied with air at low pressure, and may be fitted with any type of gas turbine.

Examples of aircraft actuation will be shown in the form of an air motor servo unit and a high-temperature screwjack for fully variable reheat nozzle actuation. The servo unit is of the rotary type with control valves and feed-back mechanism, while the jack can operate in ambient temperatures of 400°C with a stroke of 4.3in and thrust up to 1,200lb.

Some of the many fuel and hydraulic pumps made by the Plessey Aircraft Mechanical Division will be exhibited, including vane-type fuel backing pumps as used on Rolls-Royce Tyne and Conway and a centrifugal fuel backing pump and a gear type governor pump suitable for supplying a servo system with fluid at an output proportional to pump speed. This latter pump is used, for example, to operate inlet guide-vanes on the civil Avon engine and is stated to have achieved 1m flying hours without a failure. Another pump on show will be an hydraulic gear pump designed specially for missile application.

The fuel system on view will be a self-contained unit designed for small commercial gas turbines. It is equipped with a two-speed governor to control accurately engine r.p.m. at idling and maximum speed. The system is extremely adaptable and may be tailored to suit most small gas turbine, pumping, generator or compressor sets.

Completing the display of this division will be a ram-air turbine which can provide, under emergency conditions, 3½ hydraulic h.p. at 150kt.

Telecommunications equipment will be prominent. British Ministry of Aviation approval has been given to the Plessey PTR 170 transmitter/receiver and PV 141 homer. These equipments will be introduced as airborne lightweight UHF equipments for light aircraft and helicopters of all three British Armed Services. Immediate selection of any one of twelve preset channels in the band 225-399.9 Mc/s is available.

The AN/ARC 52 transmitter/receiver is manufactured under licence from the Collins Radio Co, USA. The equipment provides 1,750 channels, any 18 of which may be preset, in the UHF range 225-399.9 Mc/s for air-to-ground, air-to-air or air-to-ship communication.

A miniature VHF transmitter and inductive-loop system developed on behalf of the British Admiralty form part of the comprehensive system of flight-deck communications between flight control and deck crews on an aircraft carrier. The Telebriefing system has been designed for the RAF to enable direct audio contact to be maintained between controllers and pilots of aircraft, until the moment of take-off. The Aerial Multicoupler System is generally applicable to all H/F radio receiving stations and enables a large number of receivers to be fed from a single aerial system without loss of signal strength and whilst maintaining a low noise factor.

Several recently introduced examples of multi-pin electrical connectors will also be shown.

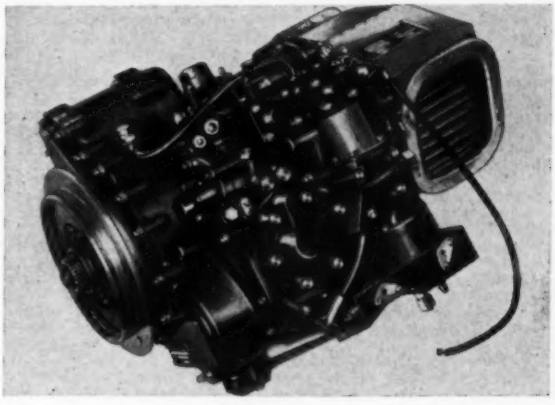
Pullin On the stand of G. Walton Ltd, the motor and servo component division of R. B. Pullin & Co will show a wide range of motors and components. DC motors are available in international frame sizes 08, 11, 15 and 18. The three largest sizes are also supplied with constant-speed governors. The "Millimotor" is specially designed for use in portable battery-operated equipment. AC motor generators sizes 10, 15/18 and 18/18 are available, and the motor portions of these assemblies can be supplied separately. Also represented will be a wide range of synchros and resolvers produced in frame size 11. Certain types are available in size 18. In-line gearboxes to suit various sizes of mechanical assemblies are available, as well as a range of plate gearboxes individually designed to customers' specifications. Transistor and magnetic-amplifier types of servo amplifier are available to drive the various sizes of servomotor.

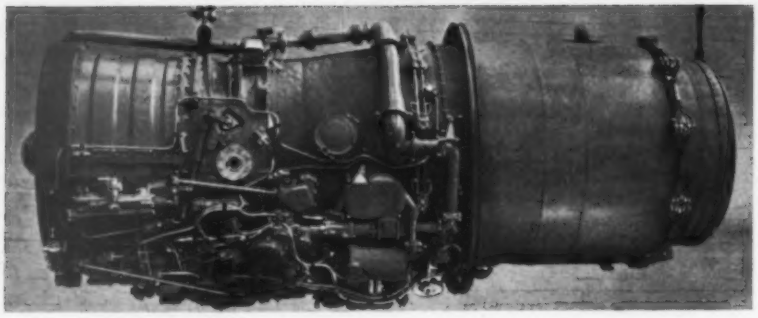
R.F.D. The R.F.D. Company recently announced that all the major French airlines are now using the company's life-saving equipment as standard. At the Show they will be spotlighting their 26-seat Universal liferaft. Fully equipped, this is one of a range available, with various modifications, to suit airline specifications for either internal valise or wing pan stowage. These rafts have been specially designed to keep pace with the needs of modern aircraft and their critical payload requirements. Also featured will be the company's wide range of inflatable lifejackets.

R.F.D.'s stand at the show, which will be under the supervision of the company's agents, the Société Commercial et Industrielle Franco-Britannique, 48 Avenue Raymond Poincaré, Paris XVIe, is to be situated in the open-air static display alongside the aircraft crash barrier.

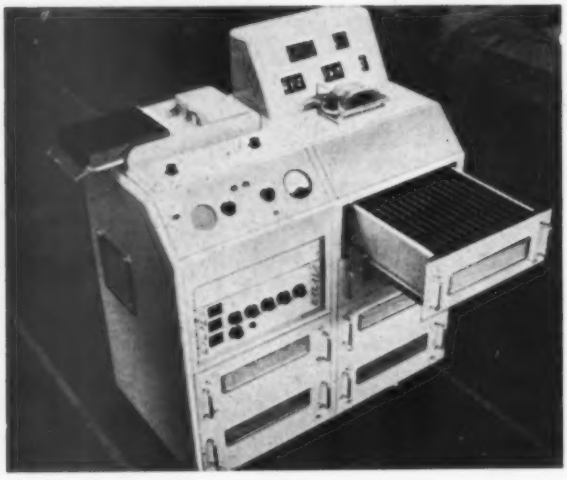
Rolls-Royce (Stand A.12) The principal Rolls-Royce exhibits are as follows: RA.29 Stage 6 turbojet of 12,725lb thrust, as fitted to the Sud Caravelle 6; RB.146 Avon of 12,220lb thrust (16,000lb with reheat), as fitted to the Dassault Avon-Mirage 111O (the same engine fitted with Swedish reheat is installed in the Saab Draken); Conway by-pass turbojet of 17,500lb thrust, as fitted to the Boeing 707/420 and DC-8-40 series (a military counterpart of this engine is installed in the Handley Page Victor B.2); and RB.163 Spey of 9,850lb thrust, as specified for the de Havilland Trident; two RB.108 light jet engines, mounted side by side, each of 2,010lb thrust (two pairs of these engines are fitted vertically in the Short SC.1, and a fifth is installed for forward propulsion); an RB.145 lightweight jet of 2,750lb thrust, suitable for VTOL aircraft; associated VTOL exhibits; two Continental light piston engines manufactured under licence—the O-200-A of 100 h.p. and the IO-470-D of 268 h.p.

Hobson Type 403 constant-speed alternator drive for D.H. Trident





Rolls-Royce Spey turbofan. Right, Rotax pneumatic starter. Below, the LMC/U playback equipment by Royston Instruments Ltd



SHOWING THE FLAG . . .

Particular interest will be aroused by the first public showing of the Spey, the subject of a description in last week's issue of *Flight*. The observation was then made that it appeared to have been largely the need to meet any future requirement for take-off or fly-over noise, rather than consideration of propulsive efficiency, which dictated the substantial increase in by-pass ratio compared with the earlier RB.141.

Rotax (Stand B.76) Three new ranges of equipment cover (1) Solid-rotor alternators of which three different sizes will be shown, ranging from 15-45kVA. The solid-rotor alternator is claimed to be unique in that there are no rotating windings, thus eliminating completely brush-wear and commutation problems. In addition, the stationary coils can be insulated with fail-safe insulation. (2) A range of low-pressure air starters used on such engines as the Conway and Tyne, together with a small combustor which is used to supply the low-pressure air to operate the starters. (3) Transistorized invertors, even more compact than those previously shown. (4) Static switches—a natural extension of the transistor field of engineering.

Royston (Stand C.168) A wide range of Royston Instruments' Midas maintenance and flight-recording systems will be shown. Highlight of the display will be the public debut of the CMM.400/7D/60 recorder, intended for civil airline use and already being evaluated by a number of international operators. This will record 270 parameters together with GMT, date, aircraft, flight and stage numbers and is primarily intended for use in routine aircraft maintenance. It has a tape speed of 0.1in/sec and a recording duration of 60hr. The machine operates on a 115V 400c/s aircraft supply. It is in two units, the first consisting of the time multiplexing switch, power supplies and electronics together with the mandatory FAA transducers. The second unit contains the tape transport and cassette and this unit is fireproofed. As in all the CMM.400 range, this unit is equipped for cassette loading. The size of each unit is 1.ATR case.

The CMM.400/7S ejectable recorder contains the tape transport and ejection mechanism, together with the recovery aids—flotation, homing beacon and marker dye. It can be used as an ancillary to the other CMM.400-series recorders, making use at the same time of multiplexing and electronics. This system allows the unit to contain an identical record to that on the main recorder, or if required it can be supplied with time-multiplexing and electronics similar to those of the CMM.400/C.

The CMM.400/7C recorder will accept 270 inputs plus 45 digits for such items as GMT and other digital data. It is in three units, comprising the time multiplexing switch, the electronics and power supply unit and the tape transport, including cassette. The tape normally runs at 1in/sec, with a recording time of 3hr. This recorder is primarily intended for flight testing.

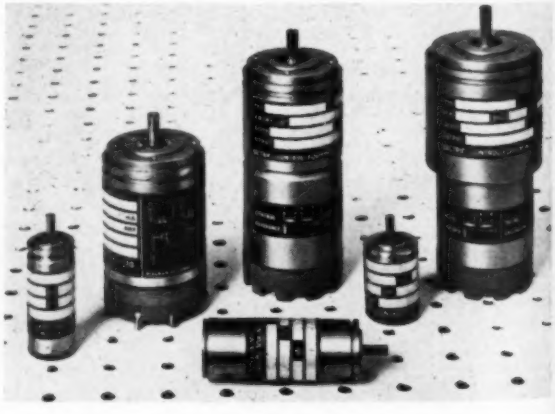
The LMC/U playback equipment is a development of the original Midas LMC and is intended for line-maintenance playback. It will accept cassettes from a CMM.400/7D/60 series recorder and playback and demultiplex one basic channel at a time, i.e., 45 parameters. It will also display the digital information—GMT, date, flight and stage numbers. It will play-back at either ten times or 100 times the recording speed.

Sperry (Stand B.73) Sperry will be represented by their new Continental European company, whose formation under the name Sperry Europe Continental was announced in March this year. The purpose of the company is to maintain the closest possible contact with Sperry's increasing number of European customers.

Both Sperry London and New York products will be displayed, among them the twin gyro platform. Employing Rotorace R bearings, this provides an attitude and directional reference of inertial quality for military strike, fighter, tactical, and reconnaissance aircraft, without the need for liquid-supported gyros. It permits rapid operational readiness and offers simplicity of maintenance, hence lower operating costs. The C11 azimuth gyro is in full-scale London and New York production. This Rotorace R directional gyro (which will be displayed in cut-away form), provides the azimuth reference for a number of NATO and civil aircraft, including a twin-mounted unit for the de Havilland Trident. Examples of Sperry's integrated instrument system will be shown, as will examples from an extensive range of gyro horizons.

In production in the U.S.A. the new SP3 has been designed to offer a sophisticated automatic pilot at a price which operators of light aircraft can afford. Block design enables the ultimate 3-axis system to be built up as the budget permits. Refinements available include automatic altitude control. An approach coupler is under development and will be available early next year. Small in size, a single-axis SP3 weighs 11lb, the full three-axis system 27½lb. The vertical gyro of the SP40 (displayed beneath a Perspex cover) will represent the complete system. Designed specifically for the medium jet market, and currently available, the SP40 employs a combination of gyroscopic and inertial techniques to afford automatic control of attitude and altitude at up

Vactric split-field d.c. motor and motor tachogenerators



Westland Rotodyne Y powered with two Napier Elands and precursor of a Tyne-powered production model

to near-sonic speeds. Total weight of the system, comprising six components, is 80lb.

Short (Stand A.15) The Short SC.1 research aircraft will demonstrate a complete VTOL flight plan. It will take off vertically from a point near the runway and, after hovering for a few seconds, climb away and go into a fast circuit of the airfield. On the approach it will decelerate gradually, making the transition from wing-borne to jet-borne flight and stopping in mid-air before landing vertically.

The work of the company in the field of VTOL will also be stressed in a display in the indoor exhibition. Against a panoramic sky background a series of small scale models of the SC.1 will be arranged to indicate the flight-path during a vertical landing and take-off. The display will also include models of Short designs for VTOL aircraft.

A 1/24th scale model of the Belfast freighter, as ordered for RAF Transport Command, will be shown with fuselage cut away to reveal models of military equipment in the hold. Another model will represent an airport freight terminal incorporating the special handling system developed by Shorts. This system has been designed to speed aircraft loading and unloading so as to exploit fully the potential of the Belfast and other large freighter aircraft. It incorporates an arrangement of powered roller conveyors which extend from the terminal right to the aircraft. Loaded pallets can thus be fed directly in and out of freight holds and marshalled as necessary inside the terminal building.

Another model will represent the Skyvan light freighter.

Shorts' stand in the guided-weapons park will be arranged to resemble the deck of a ship with ready-use magazine for guided missiles. A sectioned model of the Seacat ship-to-air guided missile will be shown. Seacat, which is being developed by Shorts under Ministry of Aviation contract for the Royal Navy, will also be fitted in ships of the Royal Australian and Royal New Zealand Navies; and both Sweden and Germany have ordered evaluation quantities. A small and highly manœuvrable weapon, powered by a solid-fuel motor, Seacat is designed for close-range defence against low-flying aircraft.

Standard Telephones (Stand 86B) Standard Telephones and Cables Ltd will be sharing a stand with some of its European associate companies. STC exhibits will include an airborne VHF ILS/VOR receiver equipment, an intercommunication system for aircraft, and two frequency-modulated radio altimeters, one of which has been specifically designed for Auto-Flare and Auto-Land use. STC has recently developed a new range of test sets for use with these and other equipments, a number of which will be presented. There will be photographic displays of ground-based navigation aids, including the Instrument Landing System type STAN/7.8.9. which has been adopted by the British Ministry of Aviation for all major airports in the United Kingdom and specified for use in Belgium, Switzerland, Canada and the Netherlands. Commutated antenna direction finders, an automatic triangulation system and a precision approach radar (P.A.R.) will be depicted.

STC's interests in the field of component manufacture for the telecommunications and electronics industries are represented by a display of valves, magnetic materials, quartz crystals, rectifiers, transistors and capacitors.

Teddington A display by Teddington Aircraft Controls Ltd is being arranged in conjunction with that of their French agents, Soc. Anon. A.B.G., and is the most ambitious that the company has so far undertaken at Paris. Instruments to be displayed are: pressure regulator Type FRK; butterfly valve Type FMP/A/5028; gate valve Type FKH/A/5; barrel valve Type FOZ; toilet servicing valve Type FKG; fuel pressure relief valve Type FPC; fuel pressurization equipment Types FLB and FLS; cyclic de-icing switch Type FHM/A/2247; a display panel showing the cabin temperature control system used on the Breguet 1150; miniature transistorized amplifier; motorized selector; ductstats; temperature selector; cyclic de-icing switch; intervalometer; a display panel showing a set of ice-warning equipment; moisture content head Type PBA; thermal switch Type PBB; switch unit Type PAG; hot rod visual ice detector Type PBE.

Ultra Electronics On Stand C.272—the aviation medicine stand organized by the Ministry of Aviation—examples of the Ultra SARAH search rescue and homing equipment will be on view. Also displayed will be an RB41B Mercury (Kalium) cell which is used to power the SARAH beacons, and an RB61 power unit. On Stand C.184 (Société de Construction de Machines Electriques & Pneumatiques Champion) examples of engine control and intercom equipment will be on view, namely, the UE91 engine condition analyser, UE902 engine vibration indicator, A605 turbine speed and jetpipe-temperature control amplifier, A203 jetpipe-temperature control amplifier, DO26 rotation indicator, A726 temperature streak detector, and UA60 communication control system.

Vactric (Stand 157C) Vactric (Control Equipment) Ltd. will be exhibiting a comprehensive selection from their range of precision servo components. These include a.c. motors and motor tachogenerators, d.c. motors, both permanent-magnet and split-field, and tachogenerators. In-line gearheads with ratios of up to 1,000 : 1 and rotary sampling switches will also be exemplified. The main feature of the stand will be a demonstration utilizing an actuator unit working continuously at a temperature of 200°C.

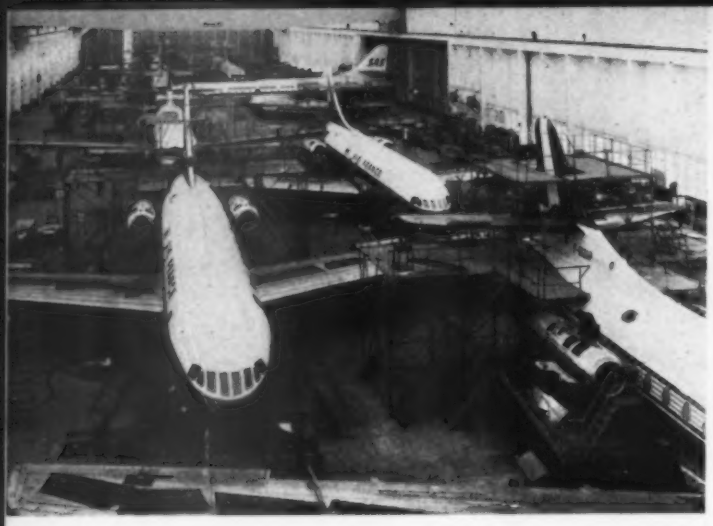
Westland (Stand A.10) Largest of five aircraft which Westland Aircraft Ltd are planning to send to this year's Salon is the world's first vertical take-off airliner the Rotodyne "Y," powered with Napier Elands. Since it last visited the Continent this aircraft has completed a considerable number of flying hours and several additions have been made, including a rotor head fairing and a central fin.

The other machines which will represent the British helicopter industry are all in current production and will comprise the 5/6-seat Nimbus-engined Scout, now on order for the British Army; the Whirlwind Series 3, which is powered by a de Havilland Gnome engine and is currently being produced for the RAF and the Republic of Ghana; the Gazelle-engined Wessex 1, now entering service with the Royal Navy; and, finally, the latest addition to the helicopter strength of the RAF, the twin-Gazelle-engined twin-rotor Belvedere.

In the static exhibition Westland will have a stand exhibiting models of all the helicopters now in their range. There will also be shown a model of the SR.N2 Hovercraft, a 27-ton 66-passenger craft now under construction at the company's Isle of Wight factory.

Illustrating important roles of Westland turbine-powered machines will be three panoramic displays showing twin-Gnome Wessex helicopters being used in an airborne assault in arid rocky country; a Scout reconnoitring jungle highlands, indicating the value of the helicopter in liaison and reconnaissance; and a Type 192 being used in conjunction with a hydro-electric scheme in remote hilly country.

Short SC.1 VTOL research aircraft with Rolls-Royce lift and thrust engines



Sud-Aviation's Caravelle assembly line at Toulouse St Martin. The Caravelle programme occupies almost half the French aircraft industry

runs test, research, telecommunications and training establishments for aircraft, engines, equipment and missiles. Overall test and evaluation responsibility rests with the DTIA, but there are two bodies broadly responsible for purely commercial aircraft, the Secrétariat Général à l'Aviation Civile et Commerciale (SGACC) and the Service de la Formation Aérienne, du Transport Aérien et du Tourisme (SFATAT).

These departments not only generate military orders and distribute work amongst the companies but provide a strong, systematic backing of basic research establishments and qualitative standards, together with a powerful market research and sales propaganda service. Sound general policy has been able not only to foster technological progress by ordering advanced and elaborate military weapons, but also to accept certain limitations in the size of the industry and to concentrate commercial ventures in those areas where the sales prospects have been most attractive. Thus, the industry is preparing both manned and un-manned weapons for

France's Aircraft Industry

DURING the past ten years the French aviation industry has achieved by steady and systematic reorganization what its counterparts in Britain and the USA have either accomplished after brief periods of turmoil or hectic years of relatively uncontrolled competition. During the first ten years after World War II the industry re-established the basic ability to produce complete aircraft and to fulfil national military requirements from home production. The French Government was the industry's main, if not only, customer.

In 1955, government and industry together took the decision to enter the international competitive field, to export existing aircraft, engines, missiles and equipment and to design new projects intended specifically for the international market. A tremendous effort to re-orientate the whole industry towards an international and competitive outlook, and to plan specifically a general expansion in every sphere, has now resulted in an export and civil turnover which, in 1960, accounted for 47 per cent of the total output; and three-fifths of the exported material has been for civil as distinct from military use. France also pioneered in co-operative, international design and production and has taken a leading part in NATO projects

In order to form a predictable basis of national military production on which exports could be planned, the French Government recently passed the military equipment programme law which sets out for the next five years the design and production effort required to meet national military requirements. All the major projects in the programme law are now known with some certainty with the exception of those for light twin-engined tactical transports, although it has been recently reported that a firm decision has been reached in this case also.

The parliamentary Act known as the *Loi Programme* in fact covers military equipment for all three Services, but particularly provides for the formation of the French national nuclear deterrent. The five years of the programme run from 1959 to 1964 and the NF11,790,000,000 (about £8,800m) involved represents 39 per cent of the total military equipment budget and only 14 per cent of the total defence budget. There are four main headings: special studies, design and production of nuclear weapons and missiles to deliver them, NF4,928,000,000 (about £36.75m); aircraft, NF4,137,000,000 (about £30.7m); combat ships and missile-carrying nuclear submarines, NF947,000,000 (about £70.8m); and ground fighting vehicles and equipment, NF1,778,500,000 (about £132.5m).

The Mirage IV for manned delivery of nuclear weapons will enter service in 1963 and have a striking range of 2,500 miles, when flight-refuelled by Vautour tankers. For the development of the missile, SEREB are receiving NF100,000,000 (about £75m) during financial 1960. Aircraft on order include 50 Mirage IVs, 270 Mirage IIIs, 50 Etendard IVs, 27 Atlantics, 70 Magisters, 220 helicopters, including some Frelons, and 80 light transports, reported to be MH.260 variants. Follow-on orders are expected for both Mirages, the Etendard IVM and Atlantics.

The industry consists of a fairly even blend of nationalized and privately owned companies whose work is broadly directed by a series of government departments headed by the Direction Technique et Industrielle de l'Aéronautique (DTIA). With the Service Technique de l'Aéronautique (STA), the DTIA performs broadly the same function as the former Ministry of Supply in Britain and the national nuclear deterrent, and at the same time has come close to capturing the international market with the much simpler light battlefield missile. No attempt has been made to enter the commercial big-jet transport field; but the Caravelle, in the medium-range class, is going from strength to strength and has even succeeded in penetrating the American domestic market. Systematic government encouragement of sport and business flying has also created what might be termed a self-contained light aircraft industry second only to that of the United States.

While tailoring the objectives in the export and civil fields to the production capacity of a relatively small industry, the government has also given full scope to the traditional French genius in aircraft design. Successive crops of promising prototypes have been allowed to progress well into the development stages, but only those with real sales potential have been allowed to go further; and although relatively few of the types now in production represent the fringe of the state of the art a strong practical background of advanced technology exists as a basis for future developments. Thus, France has led most of Europe in aerodynamics and propulsion for supersonic flight, the application of turboprop and small turboshaft engines to light transports and helicopters, tactical attack aircraft and VTOL and STOL vehicles and aircraft. France is now also in a position to produce her own nuclear weapons, tactical missiles and electronic equipment of all kinds. For years she has held a dominant position in the medium-range jet-transport field, in turbine-powered helicopters and has captured a sizeable export market with one of the world's most effective fighters, the Mirage III.

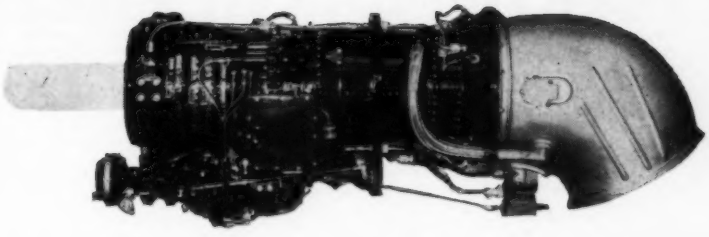
Organization and Resources

The French aircraft industry employs more than 83,000 people and occupies about 21,340,000 sq ft of factory floorspace for the production of airframes, engines, missiles and equipment. Equipment includes about 30,000 machine tools and the annual turnover is about NF2.2 milliard. Design and production work in the main airframe and engine companies occupies on an average 6,400,000 man-hours per month with an average working week of 47½ hours per man. The factories are grouped geographically round Paris, Toulouse, the south-western region (Bordeaux, Rochefort, Biarritz and Pau), the south-eastern region (Marseille and Cannes), the Nantes region (Nantes and Saint Nazaire), the central region

Caravelle wing production at Sud's factory at Bouguenais

And now

GNOMES FOR SWEDEN



The Gnome has been ordered in quantity to power the Vertol 107 and Agusta Bell 204B helicopters of the Swedish armed forces.

The Gnome is already in quantity production for the Ministry of Aviation's Whirlwind Mk.10 and Wessex 2 programmes and for the Italian Agusta 101G and Agusta Bell 204B helicopters.

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Helicopter production line at La Courneuve, near Paris, where 16 Alouette IIs are made each month

FRANCE'S AIRCRAFT INDUSTRY . . .

(Bourges, Salbris and Chateauroux) and the northern region (Méaulte).

Details of individual companies are listed in the table on page 711. Over the years each of them has come to specialize in certain fields by virtue of design and production experience rather than by any conscious direction from above. Dassault tends to concentrate on high-speed combat aircraft, Sud on helicopters, Breguet on naval and STOL aircraft, Nord on missiles, Latécoère on naval missiles and SFERMA on repair, overhaul and conversion. In addition, certain factories specialize in particular types of structure. For example Sud's Bouguenais factory at Nantes has concentrated on making wings, particularly those of the Dassault 315, Ouragan, Vautour and Caravelle.

Once an aircraft has been ordered in quantity, production is generally distributed amongst a variety of companies according to the spare capacity available and to the equipment and aptitude of the factory. A particular example is "operation Caravelle," the largest production programme ever mounted by the industry, and which involves about 200 companies all working to a single co-ordinated programme. Main contributors are Breguet, Latécoère, Hispano Suiza, Forges de la Boissière and Fiat in Italy.

While co-operative production imposed by the government was necessary both in order to obtain the required production capacity and in order to keep the companies occupied, the industry itself took steps to encourage a similar co-operation on an international scale. In 1950, M. Georges Hereil, president of Sud, founded the Association Internationale des Constructeurs de Matériels Aéronautiques (AICMA) which virtually provided a ten-nation European pool of commercial resources, design and production capacity and a means of sharing large programmes between companies on an international basis. Such an organization could only encourage commercial sales; and it has already been responsible for implementing two major NATO aircraft projects, namely, the Breguet Atlantic and the Nord Transall. The latter is principally Franco-German, though British companies provide engines and some equipment, while the Atlantic also includes Benelux.

Numerous licence agreements have been concluded both for French companies to manufacture foreign products and *vice versa*—notable examples are the Douglas agreement with Sud concerning the Caravelle and Hispano Suiza agreement with Rolls-Royce for the Tyne. In many cases the agreements make available to the companies concerned not only the products and know-how, but also the established sales and commercial organizations.

Among the airframe companies, which account for about 55 per cent of the aircraft industry and employed 47,000 people at the beginning of 1961, Sud and Nord are the major nationalized groups. Breguet, Dassault, Max Holste, Hurel-Dubois, Latécoère, MATRA, Morane-Saulnier, Potez and Sipa are the most important privately owned companies. In addition, there are four light aircraft manufacturers who, though small in themselves, have accounted for a considerable volume of production. They are Centre Est Aéronautique, Société Aéronautique Normande, Scintex-Aviation and Wassmer. About 55 per cent of the total income of the airframe companies during 1960 came from government orders and of this 90 per cent was for defence. Despite a large measure of government direction, any company, whether nationalized or privately owned, can originate new designs or form new departments. Particular examples of successful private ventures of this kind have been the Nord range of missiles, Sud helicopters, Dassault fighters and Morane-Saulnier light aircraft, culminating in the major venture of the Rallye.

Among the engine companies SNECMA is nationalized and Hispano Suiza, Potez, SEPR and Turboméca are private. Nord also has a department investigating special powerplants such as turbo-ramjets. SEPR has dominated the French rocket-propulsion field and Turboméca have been strikingly successful in the small-turbine field, where it has established a world lead. Production under licence of foreign engines, particularly Rolls-Royce, Pratt & Whitney and Bristol types, has been undertaken by SNECMA in addition to the successful development of France's own Atar turbojets. In the missile field, Nord, MATRA and Sud have been predominant and some 400,000 man-hours per month are now devoted to guided weapons. Nord's factory at Bourges, where a very high proportion of semi-automatic machinery is in use, has now turned out more than 50,000 small missiles of various types. Now, the SEREB industry/government group is engaged in the design of a French ballistic missile with nuclear warhead.

Export Organizations

French government departments have played a considerable part in obtaining export orders for French aircraft and equipment since the general policy decision to increase exports was taken in 1955. The Office Français d'Exportation de Matériel Aéronautique (OFEMA) and the Office Général de l'Air (OGA) undertake market surveys at the request of individual companies and have set up a network of commercial representatives all over the world. From the Air Ministry, the Comité National d'Expansion pour l'Aéronautique (CNEA) decides on expenditure intended to publicize French products abroad, arranges for French participation in aeronautical events and maintains contact with commercial and military attachés abroad in order to encourage exports. The industry's own organization, the Union Syndicale des Industries Aéronautiques (USIA), runs special export and propaganda departments, organizes tours and visits by groups of French aircraft and, not the least of its achievements, organizes the internationally famous Salon de l'Aéronautique in Paris every two years.

The first post-war export order was for 71 Dassault Ouragan fighters for India in 1953, later increased to 104, and for 142 Hispano-Suiza Nene engines. But this was small compared with those which have since been received for Magisters and Alouettes and the licence agreements for Magisters, Noratlas and, now, the Mirage III. By 1959 the total value of the export orders received by the industry was 45 billion old francs, but in 1960 the figure, at NF1,142,588,643 (about £84.8m), was almost two-and-half times as large. Of this total, airframes and complete aircraft accounted for NF736,221,606 (about £54.3m); helicopters for NF73,858,860 (£5.46m); engines for NF81,134,557 (£6m); missiles for NF145,137,064 (£10.75m); and equipment for NF72,500,398 (£5.32m). Some three-fifths of the total was for civil material; and the total sum is for the first time sufficient to cover the cost of operating the national air transport companies and to pay for military equipment imported by France from abroad.

The French industry has learned its lessons well. Notable successes have been achieved in the Indian and Australian markets by groups of companies working together. Operation Caravelle has been extremely useful in providing sales and after-sales know-how, Sud having based their own departments on the best foreign examples, such as Rolls-Royce, Douglas and Vickers. France's industry is now a force to be seriously reckoned with in the international market.

Final assembly of Mirage IIICs at Dassault's Bordeaux Mérignac factory. Etendard IVs are also assembled here

"Flight" photograph

Breguet 941 prototype

Dassault Mirage IV prototype with operational e

FRANCE'S AIRCRAFT INDUSTRY

PRODUCTION AND

THE following six pages form a review of French projects and production work, arranged under companies in alphabetical order. Missiles and engines are reviewed together on page 712.

Breguet Present production by this famous company is concentrated on the Alizé three-seat, carrier-based ASW aircraft, powered by a Rolls-Royce Dart Mk 21. Nearly all of the 75 on order for the Aéronavale have been completed at Biarritz, and several of a batch of 15 for the Indian Navy have been delivered. The Alizé's search radar is by CSF. In addition, Breguet have a considerable share in Caravelle sub-assembly production. The batch of 50 Fauvette single-seat gliders is complete, and there is one prototype of the two-seater Choucas for which plans are indefinite. The Chateauroux-Déols factory is overhauling USAF aircraft in Europe and an agreement to extend this work has just been concluded with Lockheed Aircraft Service.

Two major development projects are the Atlantic maritime-patrol aircraft for NATO and the remarkable 94 series of STOL aircraft employing the blown-wing principle. The Atlantic is under Breguet overall direction, with Sud, the Belgian ABAP group, Fokker and Dornier contributing major sections of the airframe. Breguet prepared common manuals for materials and standards for junction points, but individual companies have been responsible for detail design of their own sub-assemblies. This international co-operation has been excellent; the first prototype is now only one month behind the schedule fixed two years ago, and should fly in November. The second, also being assembled at Toulouse, is only three days late and will fly early next year. The first pair of 6,000 h.p. Rolls-Royce Tyne RTy.20 power-plants are now being fitted out at Villacoublay; production engines are to be made on the Continent, as noted later.

Gross weight of the Atlantic will be 90,400lb, crew 12 men, maximum and patrol speeds 330kt and 170kt, endurance 18hr and range 5,000 n.m. The crew quarters on the upper deck of the "double bubble" fuselage are pressurized, leaving an unpressurized equipment and weapons area below. Every kind of anti-submarine weapon, including AS.12 and other missiles and "special" depth charges will be carried, together with a CSF search radar and a tactical attack system more advanced than the Canadian Antac and possibly including a central digital computer. The autopilot, operating the fully-powered controls, will be tied in with the tactical system. Automatic landing will be provided for if a system is standardized by NATO.

Structure includes much metal honeycomb and integral tankage in the wing. The tip fairings are for equipment. Intention to purchase 27 Atlantics has been stated by France, and many more orders, with US financial backing, are expected from the participating countries, with the exception of Belgium, which is at the moment only taking part in the prototype programme. Britain is said to be content with the Shackleton, and so had to withdraw from the Atlantic production programme. Britain and Canada are represented on the NATO design committee.

Contributors are Hispano, SABCA and a German company, undercarriage; Hispano Suiza, MAN and FN, engines made under licence; Rotol, auxiliary drive system; D.H. Aircraft, propellers; AiResearch, a.p.u.; CSF, radar.

The Breguet 941 STOL transport was rolled out on April 23 at Toulouse and should be ready to fly at the Salon. Powered by four 1,250 h.p. Turboméca Turmo IIID turbines driving four Ratier Figeac propellers coupled by a transverse shaft, the 941 will weigh 44,000 lb, have a maximum payload of 13,900lb, be able to fly stage-lengths of 1,000 n.m. with reserves and take off over a 35ft barrier in 1,015ft. Cruising speed will be 215kt and landing distance from 50ft will be 810ft at a speed of 65kt. The very steep and slow approach are achieved by double flaps and ailerons, which deflect up to 90° and are continuously blown by the four coupled propellers. Lateral control in cruising flight and approach is assisted by spoilers and differential control of the pitch of the outboard propellers. During the approach, the outboard propellers are additionally set in fine pitch to produce some drag; and all four propellers are reversed immediately on touch-down. The pilot has a special joint power lever with reversing controls in the hand-grip. Propeller pitch is controlled from a central hydraulic unit designed by Ratier Figeac. The wing torsion box is made up of honeycomb panels and forms fuel tankage, and the special Messier Jockey undercarriage retracts into fuselage fairings.

The 940 Intégral prototype is still engaged in test and development flying, and a complete wing and power section of the 941 are accumulating static running time. While the 941 has a rear loading door and is suitable for military cargo flying, the projected 942 will have a pressurized fuselage for passenger transport. Provisions are being made for eventual all-weather operation. The 945 is a smaller, twin-Turmo, four-propeller version for tactical transport and close support. It is involved in the light tactical transport competition for the French forces. The 941 prototype was ordered by the government for possible military application, but there is also keen civil interest in the type, and BEA and other operators are following its progress. There is also a 946 twin-engined transport.

As at present installed, the transmission and control system, with numerous gearboxes, shaft bearings and individual lubricating circuits, is complex and might prove expensive to maintain. Plans already exist for a re-arrangement of the reduction-gearing stages to allow the transverse shaft to rotate at much less than its present 6,000 r.p.m. Lubricating systems would be greatly simplified, fewer shaft bearings would be needed, and weight and complexity would be considerably reduced.

Breguet 1150 Atlantic (artist's impression)

GAM Dassault A progressive and powerful company, and one of the best equipped in Europe, Dassault not only designs and builds aircraft, but also has electronics, powered-controls, missile and equipment departments. Main airframe production effort is now concentrated on the Mirage III multi-purpose strike fighter and on the Etendard IV carrier-based attack aircraft. Development flying of the Mirage IV supersonic bomber, which is even faster than the Mirage III, is continuing with the first prototype now carrying most of its operational equipment. The first of three pre-production Mirage IVAs will fly late this year and 50 are to be ordered for delivering the "French deterrent." In conjunction with Sud, Dassault are preparing a VTOL version of the Mirage III with lift engines flanking the main propulsion engine. The prototype of this promising aircraft is under construction and should fly by the end of this year. Also with Sud, Dassault are designing a supersonic transport, described under the Sud heading, and are preparing the Super Communauté or Diplomate version of the original Communauté light transport.

Six pre-production Etendard IVs were completed, one of them powered by a Rolls-Royce Avon and another fitted with a camera-bearing nose. Standard powerplant is the SNECMA Atar 8 giving 9,900lb thrust. The first of a batch of 100 for the Aéronavale, many of them photographic IVP versions, is to be completed in June and rate of production will be four per month. The Etendard is able to operate with a wide variety of under-wing stores or tanks from small carriers, and has the Dassault Aida interception and ground-ranging radar, toss-bombing computer, flight-refuelling probe and extensive high-lift devices. "Buddy" tanker packs will also be carried when appropriate. The aircraft can exceed M1 in a dive and can carry bombs, rockets or a variety of air-to-air and air-to-surface missiles, including the latest Nord AS.30. Fixed armament consists of a pack of four 20mm guns.

More than a dozen pre-production and production Mirage IIIs have been delivered, and official orders for the French air force now total more than 430. The first French squadron will be formed this year; production is well under way, the first true production

Dassault Mirage IIIO, with Rolls-Royce Avon 67 and weapons

PROJECTS REVIEWED

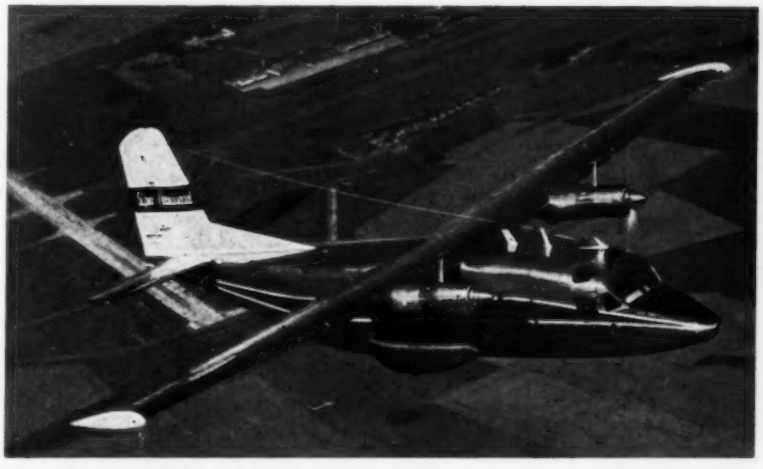
Mirage IIIC having flown in October last, and deliveries will reach nine per month in July. A great triumph for the French industry was the decision in principle by the Swiss Government to order the Mirage III, with the Atar engine, for the Swiss air force. An initial batch is to be supplied by Dassault, but the remainder will be made under licence. The engine, too, may be made partly or wholly by Sulzer Brothers. Second achievement was the order for Mirage IIIs from the Australian Government. A contract for 30 aircraft to be delivered by Dassault was signed in Paris on March 30. It is persistently reported that the CSF Cyrano fire-control, standard for French Mirages, has also been chosen for the RAAF aircraft, but Ferranti Airpass 2 is still in the running. An even bigger choice concerned the engine. A Mirage fitted with a Rolls-Royce Avon RB.146 Mk 67 (picture above) demonstrated a great increase in climb and range, but on May 17 it was announced in Canberra that the Atar—either the 9C or a new 9K version—had been chosen.

It has been reported that the South African air force, equipped like the RAAF with Sabres, might decide to buy Mirages as well. The total number of Australian Mirages, the majority made under licence in Australia, may well reach 200.

Main features of the Mirage IIIC are that it can operate if necessary from grass strips (it has low-pressure tyres) and fulfil either intercepter or ground-attack roles. Its dual-purpose Cyrano radar can direct gun-fire or air-to-air missiles and also provide navigation and terrain-clearance displays for strike missions. The thrust of the turbojet can be supplemented for interception missions by a pack containing a 3,300lb-thrust SEPR 844 rocket motor in lieu of an additional fuel tank. Fixed armament is a pack of two 30mm DEFA guns with 250 rounds each, and bombs, including a 990lb nuclear weapon, an AS.30 or R.530 missile, or tanks can be carried on a central beam beneath the fuselage. A pylon under each wing can accommodate Sidewinder or Nord air-to-air and air-to-ground missiles, bombs, rocket containers, or tanks of up to 380gal capacity. Maximum speed is M2.15 and ceiling 97,000ft. Endurance is 30min for interception and more than 3hr for ferrying. Take-off and landing runs are each stated to be 2,300ft. Gross weights range from 18,900lb to 27,700lb, according to mission, and wing loading varies from 50 to 73lb/sq ft. Minimum speed is 162 m.p.h. Starting at M0.9 at sea level, the Mirage IIIC can reach M1.8 at 49,000ft in 5 min 50sec without its rocket motor. The Mirage IIIE will have interchangeable radar or camera noses. A two-seat trainer version, designated Mirage IIIB, is also flying.

The Mirage IV has been ordered in accordance with the *Loi Programme* to form the manned delivery element of the French nuclear deterrent force. Slightly faster than the Mirage III, the IV will be powered by two SNECMA Atar 9D engines with afterburners and accommodate a crew of two in tandem. The nuclear weapon will be carried partly buried in the fuselage aft of a large flat radome. Underwing tanks will supplement independent range, but flight refuelling, either from converted Vautours or from Mirage tankers, will allow a striking range of 2,500 miles, sufficient for an escape and landing to be made in neutral territory after attacking.

Dassault Etendard IVM "Flight" photograph



Max Holste MH.260 Super Broussard

For defence, the Mirage IV is reported to have one of the most advanced radio countermeasures systems yet devised, but it is also intended that numbers of Mirage IIIs would be flown as decoys to confuse enemy defences. A Marconi Doppler and Sperry inertial platform have already been tested as the navigation system for the Mirage. Structure and configuration are generally similar to those of the Mirage III; the span is 38ft 10in and the length 77ft. Gross weight is 66,000lb.

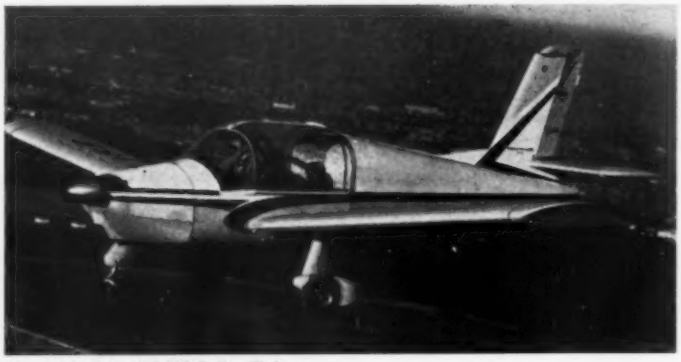
The Communauté prototype is now flying again, and Sud and Dassault have announced the Communauté A.1, powered by 1,000 h.p. Bastan IVs, in place of the original 700 h.p. Bastans, and capable of carrying 21 to 24 passengers at from 250 to 300 m.p.h. for 1,600 miles with full reserves and allowances. Most economical commercial stage-length would be 370 miles, and field length, at 16,800lb, 3,080ft. The cabin will be pressurized, have a window for each of seven rows of seats, 6ft head-room in the aisle and baggage compartments totalling 355 cu ft. A military light transport equivalent is also reported. As an executive aircraft the Communauté is very attractive, particularly as it is much cheaper than existing executive types with turbine power. Negotiations with an American company for export sales have taken place.

Max Holste Main production effort is devoted to assembly of the MH.1521 Broussard, powered by the 450 h.p. P & W R-985 Wasp Junior, some 400 of which have been ordered and 325 completed. Sipa make about 60 per cent of the airframe. The majority of Broussards have been supplied to the French services, but export orders have been received from six foreign countries. The Broussard can carry six people or a useful load of 2,130lb.

Successors to the Broussard are the Super Broussard series, powered by two 1,000 h.p. Turboméca Bastan turboprops and intended for short-haul transport from semi-prepared fields. The MH.260 prototype of the passenger/freight version has been flying for some time. The MH.261 military freighter with rear

FRANCE'S AIRCRAFT INDUSTRY . . .

Max Gardan's GY.80 Horizon



Morane Saulnier MS.880 Rallye Club

Morane Saulnier MS.760 Paris

loading door and weapons capability and the MH.262 with pressurized fuselage are in prospect. A production agreement has been concluded with Nord and the first production MH.260 should fly late this year. Certification is expected next year and production of four per month will be reached in 1963. In that year the first 262 will become available. The 261 is in the military competition for a light freighter. Government financing for 100 civil MH.260s was announced in late 1959.

Firm options are reported from Ansett-ANA for six 262s; N.Z. National Airways Corp for four 260s; Wideroe for one 260 and three 262s; Royal Air Maroc for three 260s; and Government of Cambodia for one 260. Less firm options are Trans-Australia Airlines for six 262s; East-West Airlines for three or six 260s; MacRobertson-Miller for two 260s; Portuguese Africa for six 262s. The two versions of the aircraft are complementary, in that they have identical wings, tail surfaces and engines, while the 262 offers pressurized comfort and seating for 26 instead of 23 tourist passengers. A large freight door forward in the 262 allows mixed passenger/cargo layouts, but its payload is slightly smaller than that of the 260. The latter offers a very large cabin and loading door at the rear, with a baggage compartment behind the main cabin and provision for galley and toilet.

A *Flight* handling assessment of the piston-engined prototype (*Flight*, November 13, 1959) showed exceptionally pleasant handling characteristics, a stalling speed close to 60kt and excellent behaviour on a short grass landing strip. Maximum take-off weight is 21,700lb and useful load 8,800lb. Best cruising speed is 250 m.p.h. and take-off to 35ft is 950ft at 18,700lb weight. Price of the 260 with radio is £104,000, and of the 262, £112,000.

The military MH.261 is to be powered by 1,100 h.p. Bastan Vs, weigh 13,300lb empty and 21,600lb gross, carry fuel for 5hr and be able to carry out its observation and support role for 3hr 220 miles away from its base. The military specification demands that it should carry 3,300lb of freight for 930 miles or eight stretcher cases and one attendant, or parachutists. In addition it has an aiming position in the nose, and will carry guns, rockets and light missiles. Other features include four-blade propellers, tandem-wheel main-undercarriage units and a rear loading ramp.

Cessna have acquired 47 per cent of Max Holste's capital and the French company will progressively assemble and finally manufacture the Cessna 310F and, possibly, other types.

Hurel-Dubois Since the completion of the small batch of HD.34s for the Institut Géographique National, Hurel-Dubois have obtained sub-contracts, including structural components and furnishings, for the Caravelle, rear-fuselage sections and gun-packs for the Mirage III, production design of the Super Broussard wing for Nord and manufacture of luxury seats for Air France Boeing 707s. More recently, accommodation and support have been provided for Max Gardan in the preparation of the GY.80 (see top picture).

Now, Hurel-Dubois are designing the HD.130 twin-Astazou light transport (drawing, page 680 last week) and a military observation aircraft designated HD.150. The HD.130 will weigh 12,300lb, cruise at 187 m.p.h. and carry 4,900lb for 125 miles or 3,250lb for 935 miles. Sample loads include 14 passengers or one car. It will be able to use short, rough fields. The HD.150 design, likewise turbine-engined, has been submitted to the French Services.

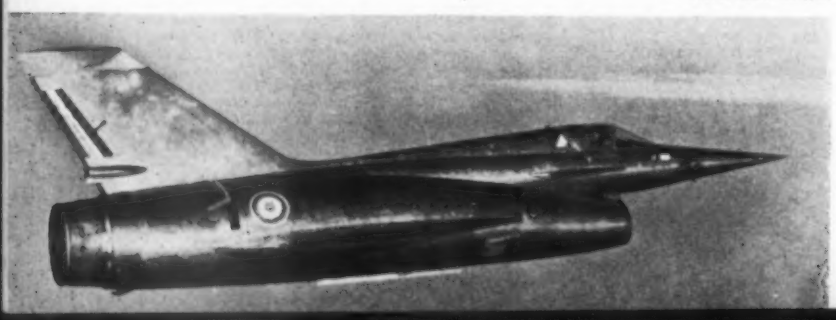
Latécoère Having concentrated since World War II on airframe sub-contracts, construction of special test equipment and on the design of missiles for the French Navy, Latécoère now has three aircraft projects. The 870 is a twin-Astazou, eight-seat, pressurized executive type with high-set swept wing and T-tail. It will cruise at 360 m.p.h. at 16,000ft and weigh 7,500lb. The 853 is a twin-Astazou freighter and the 863 is a four-Bastan, 38-seat transport cruising at 373 m.p.h. Gross weight is 31,000lb and best payload 9,900lb.

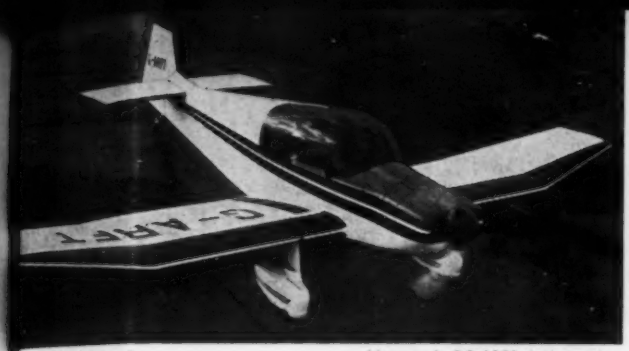
Morane-Saulnier Main production effort at the moment is concentrated on the four-seat, twin-Marboré Paris and its more powerful derivative, the Paris II. These are powered respectively by Turboméca Marboré 2 and 4 turbojets. Some 200 of both types have been ordered, many of them for the French air force, but others were exported to ten foreign countries. Licences were granted to two countries. About 100 Paris have been completed and production is at the rate of four per month. Two prototypes of the MS.1500 Epervier military close-support aircraft are reported to be still flying, and have been evaluated by the US Army, but no production order has been placed. The powerplant is a Turboméca Bastan turboprop.

Rapidly building up as a major programme is the intensive production effort at Tarbes for the MS.880 Rallye Club three-seater (Continental 90 h.p. or 100 h.p.) and the MS.885 Super Rallye four-seater (Continental 145 h.p.). This is the first light-aircraft programme in Europe which will anything like equal the rate of production achieved by the major American companies. More than 300 firm orders have been received, 125 in France and the rest from 21 countries abroad, and Morane have already decided to double the rate of production from 30 per month, which will be reached in August this year, to 60 per month from March 1962. Only nine 90 h.p. Rallyes have been ordered, compared with 142 with 100 h.p. and 160 with 145 h.p. engines.

The first prototype flew two years ago, and a prototype of the definitive production three-seater flew early this year. It was followed into the air on April 20 by the first 145 h.p. Super Rallye. Official certification tests at Brétigny are now complete, and the 145 h.p. version is being demonstrated in the USA. The Coleton company is representing Morane in the US and has already booked many tentative orders. Agencies or arrangements for assembly have been prepared in Switzerland and Australia. It is noteworthy that the

Nord 1500 Griffon





"Flight" photograph — *Normande DR.1050 Ambassadeur*

Normande D.140 Mousquetaire — "Flight" photograph

Super Rallye is considerably cheaper than the Piper Cherokee, and in many respects has better performance and handling. A 100 h.p. Rallye is to be demonstrated in Australia shortly. There will be two Super Rallyes and three Rallye Clubs at the Paris Salon.

The main objectives in the Rallye design have been to achieve simple and safe handling and economy of operation with extreme simplicity of structure for mass-production. The aircraft is relatively conventional, but has extensive high-lift devices, including automatic leading-edge slats and Fowler-type, manually operated flaps. The structure is all-metal, and a good deal of fluting to stiffen the skins, and spot-welding, is employed. The three versions available differ only in seating and engine power. Principal data for the 145 h.p. version are: span, 31ft 4in; length, 22ft 6in; maximum speed, 143 m.p.h.; cruising speed, 124 m.p.h.; stalling speed, 53 m.p.h.; range, 500 miles; take-off run, 395ft.

Nord-Aviation Airframe, missile and test-vehicle design and production occupies the considerable industrial potential of Nord-Aviation. Construction of 261 Noratlas transports, the great majority for the French air force, is virtually complete, as are the 154 built under licence in Germany. The whole batch of 150 type 3400 observation aircraft for the French army has been completed, and some 55 of the 100 type 3202 trainers have been delivered, also to the French army. At its Méaulte factory, Nord is making wings for the Dassault Mirage III, and has virtually taken the leading role in the manufacture of the Holste MH.260 Super Broussard, the first production example of which should appear late this year. Production will reach four per month a year later. The pressurized fuselage of the MH.262 is also being designed by Nord.

A major design project is the NATO assault transport, the Transall C.160, of which three prototypes and two static-test airframes are being built by Nord and a group of German companies. Powered by two Rolls-Royce Tynes giving 6,100 h.p. each, the Transall will weigh 97,900lb and have a maximum payload of 30,800lb. Rear loading ramp and Messier Jockey tandem-wheel main undercarriage will allow tactical heavy freighting from semi-prepared ground. Maximum range will be 2,800 miles, and cruising speed 312 m.p.h. Take-off and landing distance over appropriate obstacle heights will be 1,970ft. Germany will order 200 Transalls if the prototypes prove satisfactory.

Research into airframe heating and propulsion by turbo-ramjet at speeds beyond M2 is continuing, under a USAF research contract, with one of the two Griffons built some years ago. This aircraft has set a world closed-circuit speed record and is still unique in employing turbo-ramjet power. Speeds in excess of M2.2 have been achieved, and the pilot, André Turcat, was awarded the Harmon Trophy last year for his work. The turbojet is a SNECMA Atar E3.

Nord have also proposed an STOL version of the Noratlas and are working on a supersonic VTOL fighter using Bristol Siddeley lift/thrust engines, probably of the BS.53 Pegasus type.

Société Aéronautique Normande A highly successful production and sales team headed now by Mme Lucien Querey have followed several hundred early Jodel two-seaters with the DR.1050 Ambassadeur three-seater (90 h.p. Continental) and the D.140 Mousquetaire four-seater (180 h.p. Lycoming). Some 250 Ambassadeurs have been completed and the production line completes 12 per month. A second production line is now making five Mousquetaires per month and 65 have been completed. Both types have been extensively exported and performance is excellent. Air test reports of both types appeared in *Flight* for November 25, 1960. The after-sales department is steadily expanding as sales increase.

The Ambassadeur is also produced by the Centre Est Aéronautique.

Potez-Air Fouga Production activity in the aircraft section of Potez-Air Fouga is centred on completion of the 450 Magister trainers, of which about 350 have been delivered. Licence production abroad brings the total of Magisters ordered to 720. The first batch of Zéphyrs for the French Aéronavale has been completed. Developments of the Magister include the Mk VI, with more powerful Marborés, and the CM.191 command transport and executive version being built by Heinkel in Germany, which should make its début at the Paris Salon. A four-seater, it is powered by two Marboré VIs and will carry a payload of 880lb for 930 miles at 435 m.p.h.

The other Potez project, the 840, claims the distinctions of being the first aircraft designed specifically for the Astazou and France's first turboprop airliner. A 16/24-seater powered by four Astazou 2s, the prototype made its first flight early this month at Toulouse. Maximum range will be 1,240 miles and useful load 6,600lb for a gross weight of 15,360lb. The 16 passengers will face forwards while the 24 would face inwards. Cruising speed is 305 m.p.h. The first prototype will be followed by a second, and parts for two more are also being made. Design and construction has been very rapid, under the personal direction of M. Potez; and a market study carried out by OFEMA is stated to have forecast a world market for 1,000 aircraft.

Scintex-Aviation As one of the four main light aircraft manufacturers, Scintex is making five CP 301C Emeraude two-seaters per month and has so far delivered more than 220 of them, including exports to ten foreign countries. Production licences have been granted in 12 countries. With a 90 h.p. Continental engine the Emeraude cruises at 118 m.p.h. and has a range of 620 miles. The factory is at Riom.

More recently, Scintex have been flight-testing their four-seat 180 h.p. Rubis, and plan to make 50 in a new factory being built at Limoges. Cruising speed of this type is 149 m.p.h.

Sipa After some years devoted mainly to sub-contract work and production of airline cabin equipment, Sipa are now engaged in the design of a light freighter powered by two Turboméca Astazou turboprops. Various versions have been proposed. The company made 4,600 airline seats during 1960, 1,800 of them for export, and 18 complex galley installations. The electronic department produced 1,800 magnetic amplifiers for aeronautical and other applications. Airframe sub-contracts include 60 per cent of the Holste Broussard, and smaller portions of the Caravelle, Mirage III and Alouette II. Overhaul of 30 Piper observation aircraft of the French army was also completed.

The new light freighter is the S.272 Présence, powered by two Turboméca Astazous giving 530 h.p. each, and capable of carrying 12 or 16 passengers or a car in a pressurized cabin. The complete cockpit section swings aside to allow straight-in loading from the front. Metal has not yet been cut, but it is thought that a healthy market exists, both for scheduled operations and executive work. The prospects of an increase in Astazou power to 600 h.p. offers even better performance; and a military short-field version is also being considered.

Like the Dove, the S.272 has a low wing, with the engines mounted high and short main-undercarriage legs retracting sideways (inwards) into the wing. Span is 57ft 3in and equipped weight, in passenger form, 6,600lb. Gross weight is 10,700lb, and cruising speed will be 258 m.p.h. Freight payload will be 2,800lb over 620 miles, or 3,360lb over 310 miles. Take-off distance to 50ft will be 1,750ft.

SFERMA As Europe's largest specialist repair, overhaul and conversion organization, SFERMA, a subsidiary of Sud-Aviation, has steadily expanded over the years and diversified its activities. Fully equipped workshops at Bordeaux, out-stations at Le Bourget and elsewhere and the factory at St Nazaire handle major work on a wide variety of both French and American civil and military aircraft. One major task was the conversion of a Douglas DC-6 into a DC-6B in record time. The company is now refurbishing about 100 Douglas AD-4 Skyraiders for French air force use in North Africa. Instruments, radio, hydraulic and other systems can be overhauled, and large stocks of parts and materials are held.

In the engine field, SFERMA have set up a model installation for the overhaul of Turboméca Palas, Palouste and Artouste turbines and now offer Palas booster pack kits for C-46 and DC-3 aircraft. Carrying their co-operation with Turboméca even further they have completed conversions to Astazou power of the Holste MH.153, Nord 1110, Beech 18, Travel Air and Dornier Do 27. These installations have been developed and tested by SFERMA, the Beech types having been converted in collaboration with Beech in Wichita. The latter work has now resulted in an agreement under which SFERMA are assembling Baron airframes and fitting them with Astazous. Eight airframes are now at

Potez-Air Fouga 840

Beech Travel Air converted to Turboméca Astazous by SFERMA

Sud Alouette II

Sud Alouette III

FRANCE'S AIRCRAFT INDUSTRY . . .

St Nazaire for conversion, six of them already sold, and SFERMA will market the new aircraft under the name Marquis in Europe, and perhaps in America as well. Piston-engined Barons may also be made under licence. The first Travel Air with Astazous has now been converted to Baron standard and FAA certification to CAR.3 is being obtained.

With its comprehensive installations, SFERMA has also undertaken some production work, including machining of large structural components for other manufacturers. While such work continues, SFERMA will expand the Astazou field and will benefit from Beech's sales network in Europe. The company may also produce a single-Astazou executive aircraft of its own design at a later date.

Sud-Aviation (fixed wing) Sud is the largest single company in the French aircraft industry, and has been responsible for the highly successful Caravelle project and for virtually all the helicopters designed and built in France. The basic Caravelle is being progressively developed, now with the co-operation of Douglas and General Electric, and two new jetliners are also under development. One is the Caravelle Junior. Although Sud have officially stated that this aircraft has been abandoned, contracts for British engines and equipment have not been cancelled. The other project is a joint Sud-Dassault M2 supersonic transport which, Sud state, could be in service in 1967.

The Caravelle Junior would be a 45-seater weighing about 66,000lb. Its fuselage could be built in Caravelle jigs, but the wing would be new. The two engines would be mounted at the tail; Rolls-Royce Speys have been chosen, although the lower-powered Bristol Siddeley BS.75 and SNECMA (P & W) JTF-10 are also in the running.

The supersonic Sud-Dassault Super Caravelle project will weigh between 155,000lb and 170,000lb and carry between 70 and 76 passengers over stage lengths of 1,800 n.m. with reserves. It would be able to use current runways, provide cockpit visibility in conformity with FAA specifications and be able to make normal ILS approaches. Autopilot and stability augmentation would be provided, and automatic landing might be provided, but the aircraft would be controllable in all flight conditions without artificial aids. A delta wing—perhaps related to the Mirage family—will be used, possibly with a foreplane, and the four conventional turbojets may have limited afterburning. Sud consider the optimum speed range to be M2.0 to 2.2, the aircraft exceeding M1 only above the tropopause. Supersonic booms over land should not prove troublesome, Sud say.

Automatic landing is also being developed for the standard Caravelle, possibly using a limited Lear automatic installation in which pilot take-over in case of failure would be necessary. Ground-based guidance systems of many kinds, including French improved ILS and ASV.23 microwave systems, are being contemplated. The second prototype Caravelle is being equipped for trials.

The effort that Sud Aviation and its subcontractors are putting into the Caravelle family of jet airliners today involves about half the productive capacity of the French aircraft industry. Like all successful aircraft, France's short/medium range jet airliner has been—and continues to be—developed in a variety of versions. Among these are variants in which US companies have a stake: Douglas have a licence to market, service and possibly reverses, which permit a higher maximum weight (over 110,000lb).

Other variants are the G.E.-engined **Caravelle 7**, which has a small (3m) fuselage extension and a maximum weight approaching 115,000lb. The **Caravelle 10** has the P. & W. engines. Variants that have been dropped include the **Caravelle 8** (Rolls-Royce R.B.141s) and **Caravelle 14** (R.B.141s and a new M0.84 wing).

The Caravelle order book now accounts for more than 110 aircraft sold, as follows: Air France, 33; Air Algerie, 6; Air Liban, 1 (leased from Air France); Alitalia, 14; Finnair, 4; Iberia, 4; Royal Air Maroc, 2; Sabena, 6; SAS, 14; Swissair, 8; Tunisair, 1 (leased from Air France); United, 20.

Another joint Sud-Dassault project is the Diplomate development of the Communauté which first flew two years ago. If production orders were forthcoming, Sud would make 80 per cent of the airframe. Finally, Sud are co-operating with Dassault in the design of the VTOL version of the Mirage III: this project, too, is dealt with in the Dassault review.

A minor Sud project is the rehabilitation and conversion of 135 North American T-28 Nomads for use in North Africa. Of these, about 80 have been completed, and work continues at the rate of seven per month.

Sud-Aviation (helicopters) Sud holds a virtual monopoly in helicopter design and production in France and was for four years the only producer of turbine-powered helicopters in the world. The series of 150 Djinns has been completed, but 16 Alouette IIs, powered by Turboméca Artouste 2 turboshaft, are being made per month. Altogether 750 have been ordered and 570 completed—a masterly achievement. The 500th Alouette II was one of 14 sold to the British army last year, and

Wassmer Super IV Sancy

Sud Caravelle 6R for United Airlin es

Sud Frelon prototype

22 other countries have bought the type for civil and military use. A five-seater, the Alouette II has a constant-speed transmission making for simplicity of piloting. Its performance at altitude has been proved by numerous records and landings at considerable heights on mountains. Saab in Sweden and Republic Aviation in America both hold a production licence, and Republic have demonstrated dropping of homing torpedoes from float-equipped Alouettes based on destroyers. Nord SS.10 and SS.11 missiles have been fired, and a variety of specialized civil and military equipment is available. Cruising speed is 108 m.p.h., endurance 3hr 15min, and payload for a 62 mile flight is 1,040lb.

An important recent development of the Alouette II is the fitting of an Astazou 530 h.p. turboshaft engine. Very little modification is required, but range is considerably improved, and production of this version seems likely. Another development is a remote-controlled version, with autopilot, for flying over areas where radiation, smoke or similar hazards make human access dangerous.

Two years ago Sud produced the prototype Alouette III which seats seven people, has a monocoque tail-boom and faired centre section, and is powered by the 700 h.p. Arouste IIIB derated at sea level to 550 h.p. Two prototypes were followed by four pre-production aircraft, two of them for the French army. Export orders from Sweden, Burma and South Africa have already been received and the first production aircraft should be completed in July. An Alouette recently landed at 19,700ft with two people and 550lb of load in the Himalayas. Sud are moving their helicopter production lines, with the exception of the rotor blade unit, from La Courneuve to Marignane, where the Sikorsky HSS-1 and H-34 (S-58) are already in production under Sikorsky licence. Almost all the 252 S-58s have been completed; most are for the French Services, but some are now also being exported to Belgium. There are plans to fit HSS-1s with two Turboméca Bastans, which would greatly improve their performance and give them twin-engined safety. There should be considerable conversion opportunities among the 400 S-58-type helicopters now operating in Europe.

The largest indigenous Sud helicopter design is the SA.3200 Frelon, two prototypes of which have been flying for more than two years. Originally intended to serve all three French Services, but also to meet possible civil requirements, the Frelon suffered tail-rotor vibration troubles, and has also been overtaken by considerable increases in the power of the Turboméca Turmo engine. A new version, designated 3210 Frelon is now in the development stage. It will be powered by three Turmo IIIs, each giving 1,250 h.p.—the earlier Turmos gave 700 h.p.—and have a six-blade main rotor and flying-boat hull. Gross weight will be increased from 17,600lb to 24,200lb. The prototype is under construction, and production is provided for in the *Loi Programme* covering the next four years.

Finally, Sud are engaged with German and Italian companies in a NATO project for a crane helicopter, reported in one instance to be Sikorsky S-61D or S-64, which will be mainly financed by Germany.

Wassmer A considerable number of light aircraft and gliders have been made by Wassmer, including 150 Jodel D.112 two-seaters, 195 D.120 Paris-Nice two-seaters (Continental 90 h.p.) and 60 Javelot single-seat gliders. The company is at present concentrating on production of the D.120 at six per month and on the Javelot, but production of the 180 h.p. four-seat Super IV Sancy is also under way and more than 17 have been sold. This type has the Lycoming O-360 engine and carries four people, baggage, ample radio and fuel for six hours. Its best cruising speed is 165 m.p.h. and best range 960 miles. The steel-tube fuselage is plastic- and fabric-covered and the cabin is covered by a single-piece sliding canopy. The wing is wooden, with plywood covering and has a deep, laminar flow section. An air-test report in *Flight* for April 27 indicated good handling on the ground and in the air and excellent visibility. The Super IV is comparable in most respects with the Comanche 180.

In the advanced development stage is the Bijave two-seat glider which competed for government orders with the Breguet Choucas. The relative merits of the aircraft were lost in a political battle between the two companies, but Wassmer intend to produce the Bijave.

The Wassmer factory at Issoire is well equipped with wood-working, steel-tube, sheet metal, fabric and plastics departments—some 40 components of the Super IV are in plastics—and sub-contracts have been undertaken for the Atelier Industriel de l'Air.

AIRFRAME MANUFACTURERS

Name and Head Office	Capital New Francs	President	Location of Works	Floor Area (m²)*	Personnel
Société Anonyme des Ateliers d'Aviation Louis Breguet 24, Rue G. Bizet Paris 16. Tél. PAS. 90.93	16,250,000	S. Floirat Président	Villacoublay-Velizy Toulouse Bayonne-Anglet Chateauroux-Déols Biarritz-Parme	129,000	4,400
Générale Aéronautique Marcel Dassault 78 Quai Carnot Saint Cloud (S. & O.) Tél. MOL. 36.80	22,563,000	M. Vallières Gérant Directeur Général	Saint Cloud Argenteuil Boulogne Talence Mérignac Melun-Villaroche	160,000	5,500
Société Anonyme de Construction des Avions Hurel Dubois Route de Verriere Meudon (S. & O.) Tél. OBS. 27.90	8,200,000	L. J. Dubois Président	Villacoublay-Meudon	14,500	510
Latécoère 79, Av Marceau Paris 16. Tél. PAS.01.05	1,500,000	Mlle. J. Ligonnet Directeur Général	Paris Toulouse	17,984	1,100
Engins Matra 49, Rue de Lisbonne Paris. Tél. WAG. 59.50	10,000,000	M. Chassagny Président Directeur Général	Boulogne Paris Salbris Courbevoie	18,175	1,100
Avions Max Holste 11 Rue Gosset Reims (Marne) Tél. 47.26.65	2,200,000	M. Holste Président Directeur Général	Reims	10,000	450
Société Anonyme Morane Saulnier 3, 5 Rue Volta Puteaux (Seine) Tél. LON. 21.94	3,168,000	R. Saulnier Président	Puteaux Villacoublay Ossun-Tarbes	57,000	1,780
Nord-Aviation SNCA 12bis Ave Bosquet Paris. Tél. INV. 40.71	45,250,000	P. Mazer Président Directeur Général	Chatillon/s Bagneux Bourges Les Mureaux Méaulte Melun-Villaroche Gatines Toussus-le-Noble	261,000	7,890
Etablissements Henry Potez (Potez-Air Fouga) 46 Avenue Kléber Paris 16 Tél. KLE. 27.83	4,750,000 (+750,000)	H. Potez Gérant Directeur Général	Argenteuil Saint Cloud Suresnes Dreux Toulouse Aire s. Adour	75,000	2,000
Scintex-Aviation 65 Rue de l'Industrie Courbevoie (Seine) Tél. DEF. 06.69	2,400,000	J. M. Vernhes Président Directeur Général	Courbevoie Riom	1,200	50
Société Aéronautique Normande SAN Aérodrome de Bernay (Eure) Tél. 593	150,000	Mme L. Querey Président Directeur Général	Bernay	3,200	70
Société Française d'Entretien et de Réparation de Matériel Aéronautique SFERMA 3 Quai Galliéni Suresnes (Seine). Tél. LON. 58.24	7,790,000	M. Bardré Président	Bordeaux-Mérignac Neuilly Le Bourget St. Nazaire	45,000	1,350
Société Industrielle Pour l'Aéronautique SIPA 40 Rue J-J. Rousseau Suresnes (Seine) Tél. LON. 45.35	1,000,000	G. Arm Président Directeur Général	Suresnes Villacoublay	18,000	600
Sud-Aviation SNCA 37, Boulevard Montmorency Paris 16 Tél. BAG. 84.00	166,500,000	G. Hereil Président Directeur Général	Toulouse Marseille-Marignane Bordeaux-Mérignac Saint Nazaire Nantes-Bouguenais Rochefort La Courneuve Cannes Courbevoie	600,000	23,000
Wassmer 11 Rue E. Dolet Paris 20 Tél. MEN. 21.33	100,000	J. P. Dumont Directeur Général	Issoire (P. de Dôme)	3,600	100

*1m. = 10.76 sq ft

France's Aircraft Industry . . .

Launch of a Nord SS.11 from a Bell Iroquois

MISSILES AND ENGINES

MISSILES

DEFA The Direction des Etudes at Fabrications d'Armément is a government organization which, *inter alia*, has evolved many types of missile and test vehicle. Their Entac (Engin Tactique Anti-Chars) wire-guided infantry weapon has shown itself to be one of the best in its class, and earlier this month it was adopted as a standard missile by the US Army.

Latécoère Famed for a long series of naval aircraft, this firm is now concentrating upon naval missiles. The two of which details may be published are Malaface, a ship-to-ship device weighing 3,307lb, and Malafon, a surface-to-underwater missile weighing 2,865lb. Both have an aeroplane-type configuration and relatively low flight speed.

Matra In addition to the production of spin-stabilized air-to-air rockets and launchers, Matra have concentrated upon air-to-air guided weapons for the Armée de l'Air. The R.511 serves as an indoctrination weapon with Vautour squadrons, and the new R.530, looking rather like a delta-winged Firestreak, can have either IR or semi-active radar guidance, and is scheduled to enter service next year.

Nord Approximately 60,000 guided missiles have now been delivered by Nord-Aviation, and a considerable proportion of these have been exported. The classic SS.10 wire-guided 33lb anti-tank missile is still in production for infantry, vehicles and aircraft in many countries. The 63lb SS.11 is in bulk production for many countries, and is widely used by the US 7th Army in Europe, and by many air forces as a training and air-to-surface missile. The 150lb SS.12 is completing development, and can have wire or radio guidance; the AS.12 variant is carried by the Alizé aircraft. Many thousands of AA.20 and AA.25 air-to-air weapons are in use, and the 1,150lb AS.30, which can carry a nuclear warhead, is in an advanced stage of development as a standard air-to-surface missile.

SEREB A consortium of the largest aviation and missile groups, this company was formed in 1959 to manage the French IRBM development and promote space research. It is now collaborating with Hawker Siddeley Aviation in the latter sphere.

Sud Since 1950 Sud-Aviation have developed the 4200 and 4280 series of ramjet-propelled bombardment missiles. Many hundreds have been delivered.

ENGINES

CGTM Formed by Turboméca, Sud and Hispano Suiza, the Compagnie Général des Turbo-Machines is primarily a development company for the flight testing of turboprops. During January CGTM began flying the third Dassault-Sud 117 Voltigeur prototype for the flight development of the Bastan IIIA.

Hispano Suiza In addition to producing the SEPR 844 rocket-boost package for the Mirage IIICs of the Armée de l'Air, this famous company are maintaining their long tie with Rolls-Royce by assuming responsibility for the licence-manufacture of Tyne RTy.20 engines for the Breguet 1150 Atlantic and Transall C.160.

Nord For many years specialists in subsonic and supersonic ramjet propulsion, Nord hold a USAF research contract in this field for work stemming from the 54in-diameter engine which has exceeded M2 in the Griffon. The 25.2in ST.600 Sirius has reached M2.4 in the Nord CT-41 target, and already 30 have flown, 20 more have been built and 20 reached the assembly stage. The new Vega test vehicle utilizes an integral engine of the same diameter, but capable of reaching M4 or M5. At M4 it delivers 1,390lb thrust at 82,000ft.

Potez Since 1945 this renowned company has specialized in small air-cooled piston engines, and their most important current productions are the 4D.34, a 260 h.p. blown inverted four-in-line, and the flat-four 4E.20, rated at 90 to 105 h.p. The 4D.34 is fitted to the Nord 3202 and 3400; by April 1 a total of 285 had been delivered, and production was running at 15 engines monthly. The flat-four only entered production in December, but production is already 20 engines per month.

SEPR During the past 17 years this company has concentrated exclusively upon propulsion by liquid and solid rocket motors. Many hundreds of solid-propellant units have been delivered for boost and sustainer propulsion of missiles, and production is also in hand on the SEPR.844 booster package for the Mirage III. The 844, bulk deliveries of which are being made by Hispano Suiza, has a single chamber pump-fed with nitric acid and kerosine; thrust at 52,500ft is 3,740lb, and equivalent s.f.c. 4.35.

SNECMA Easily the largest aero-engine company on the Continent, SNECMA have since 1950 delivered large numbers of four- and 12-cylinder piston engines, and over 1,250 Hercules 759s made under Bristol (now Bristol Siddeley) licence. Much the largest programme has concerned the Atar turbojet, well over a thousand of which are in service in Mystère and Vautour aircraft. The Atar 8 was evolved by adding a zero-stage and other detail refinements, and is in production at a rating of 9,700lb for the Etendard IVM. The Atar 9C has a fully variable afterburner, and quantity production is in hand for the Mirage III family. Sea-level static rating, with reheat, is 13,230lb, and an automatic throttling system gives an output at 33,000ft and M1.4 equivalent to a sea-level rating of 14,110lb, with s.f.c. of 2.03; engine dry weight is 2,998lb. For the Mirage IV bomber SNECMA are developing the Atar 9D, in which further improvements in materials and reheat give an M1.4, 33,000ft output equivalent to 14,990lb at sea level; static thrust at take-off is 13,560lb. An even later variant is the 9K, for the RAAF Mirages. At the end of 1959 SNECMA announced an agreement with United Aircraft, allowing them to service a wide range of Pratt & Whitney piston and turbine engines in Common Market countries, and to manufacture spares and complete engines.

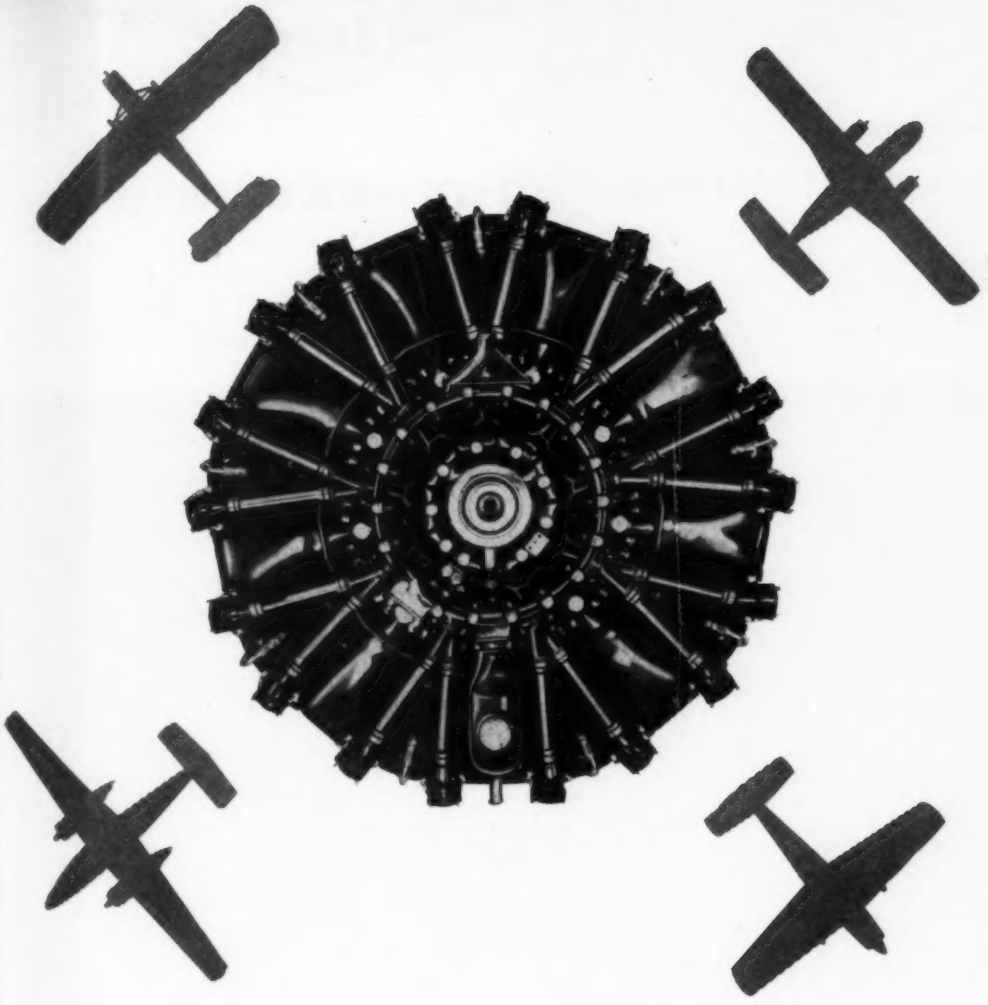
Turboméca Starting with a 177lb-thrust turbojet which flew in 1949, this firm is today the most famous manufacturer of small gas-turbines in the world. Production licences have been granted to Blackburn (UK), Continental (USA), ENMASA (Spain) and a State plant in Yugoslavia, and output at Bordes is running at some 100 engines monthly. The Marboré turbojet remains in production at ratings of 880 or 1,100lb. Of the turboshaft units, the most successful has been the 400 h.p. Artouste 2, well over 1,200 of which have been delivered—chiefly for Alouettes—and the free-turbine Turmo family. The Breguet 941, 942 and 945 will have the Turmo 3D rated at 1,208 s.h.p. and the Sud 3200 Frelon helicopter the 3C rated at 1,183 s.h.p. Among turboprops the field is dominated by the Astazou and Bastan, both of which have zero-stage axial compressors upstream of the centrifugal stage, and a three-stage turbine. The Astazou 2 is rated at 554 e.h.p. as a turboprop and 523 s.h.p. as a shaft-drive unit, and weighs 447lb with propeller; the larger Bastan is rated at 922 or 986 e.h.p., and at max continuous power has an s.f.c. of about 0.61. Due to be disclosed at next week's Salon, the new Turboméca by-pass engine has a static rating of 1,700lb, and a cruise thrust of 420lb at 29,000ft with s.f.c. of 0.88; it has been chosen for the Saab-105 transport.

Atar turbojets in final assembly at SNECMA's Kellermann factory in Paris

ENGINE MANUFACTURERS

Name and Head Office	Capital New Francs	President	Location of Works	Floor Area (m^2)*	Personnel
CGTM Compagnie Générale des Turbo-Machines 26, 32 Rue de Villiers Levallois-Perret Tél. PER. 32.85	750,000	M. Guibert Président Directeur Général	Paris Istres	3,650	108
Hispano Suiza Rue du Capt. Guynemer Bois-Colombes (Seine) Tél. CHA. 38.80	5,000,000	R. Bloum Président Directeur Général	Bois-Colombes Courbevoie Bouviers Verrières Marignane	95,000	4,200
Nord Aviation Departement Moteurs 12 Rue Béranger Chatillon-sous-Bagneux (Seine). Tél. ALE. 71.40	45,250,000	Paul Mazer Président Directeur Général	Chatillon	261,000	7,890
Etablissements Henry Potez 46 Avenue Kléber Paris 16. Tél. KLE. 27.83	4,750,000	H. Potez Gérant Directeur Général	Argenteuil Saint Cloud Suresnes	75,000	2,000
Société d'Etude de la Propulsion par Réaction SEPR 1 Voie des Sables Villejuif (Seine) Tél. ITA. 57.69	6,368,400	G. Fleury Président Directeur Général	Villejuif Argenteuil Istres	11,500	800
SNECMA 150 Boulevard Haussmann Paris 8 Tél. CAR. 33.94	76,114,750	H. Desbruéres Président Directeur Général	Paris-Kellermann Billancourt Gennevilliers Suresnes Melun-Villaroche	206,000	9,000
Turboméca Bordes (Basses Pyrénées) Tél. PAU 49.32	11,375,000	J. Szydlowski Président Directeur Général	Bordes Mezières s. Seine	45,000	1,600

* $1m^2 = 10.76$ sq ft



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How long has it been an airport?

First built as an airfield for R.A.F. Transport Command in 1944, on the site of the Fairey Aviation Company's small grass aerodrome known in the 1930's as Harmondsworth (Heathrow), it was taken over by the Ministry of Civil Aviation at the end of 1945. The first proving flight was made in January, 1946 and the first passenger service was flown on June 1 of the same year.

How big is it now?

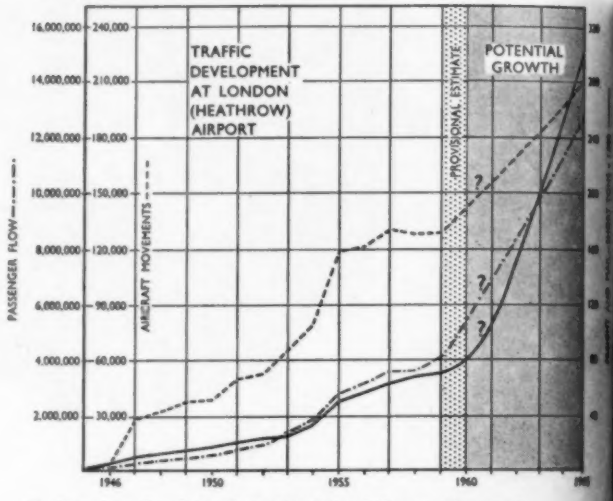
The airport covers 2,705 acres with a boundary length of 12 miles. There is enough concrete in the five runways, roads and taxyways to build a first-class road from London to Edinburgh. It's a town in itself and a busy one at that, with its own fire service, police force and bye-laws, a telephone exchange and a total staff of 28,000.

What's going on in the picture below?

This shows an Esso crewman in the control compartment of a Python refueller. These 55-foot-long Pythons are a familiar sight at London (Heathrow). Each has a capacity of 12,000 Imperial gallons. High-speed hydraulic motors drive the two centrifugal delivery pumps to provide a pumping rate of 1,000 gallons a minute—500 from each of two hoses. As always, precise filtration is a key factor in Esso service and all fuel supplied by the Python passes through 2½-micron filter separators.

How has traffic developed since 1946?

This graph gives the answer:



Today aircraft of 46 of the World's airlines make regular use of Heathrow and the airport is the busiest in the World outside the U.S.A.

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With a staff of 130 and a fleet of nearly fifty refuellers, trailers and other mobile dispensing equipment to suit every need however large or small, Esso handles a million gallons of fuel a week at Heathrow. Its storage tanks at the Perry Oaks fuel farm hold this amount—plus nearly half as much again in the tanks at the Central Area Plant. And out at Perry Oaks Esso now has its own manufacturing plant for water methanol and demineralised water.

And how about the future?

Airport facilities are expanding rapidly. No. 5 runway is being extended to 11,000 feet, the long-haul passenger building now under construction in the Central Area is due for completion soon and a new permanent freight building should be ready in 1963. As for Esso's plans, they are based on the determination to stay two steps ahead of current demands, to provide safe service fast whatever the need and ensure that fuel service will never be a limiting factor for the rapidly-growing air traffic of tomorrow.

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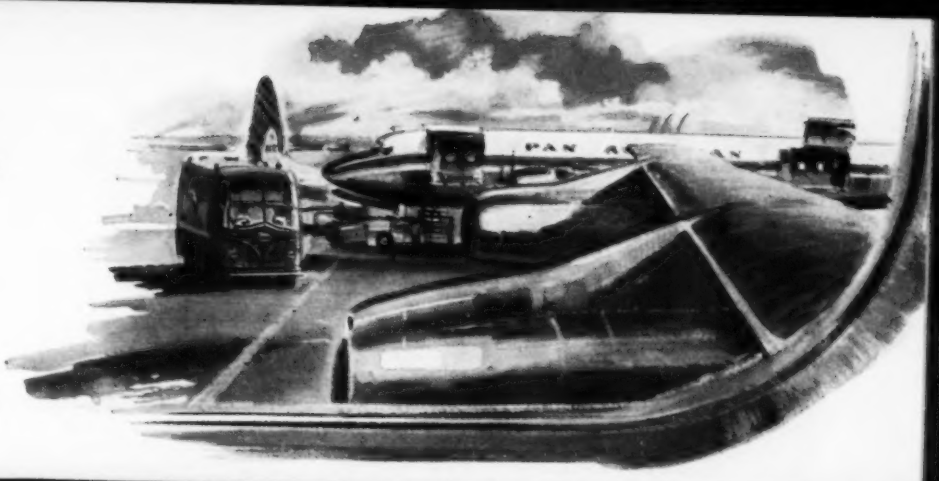
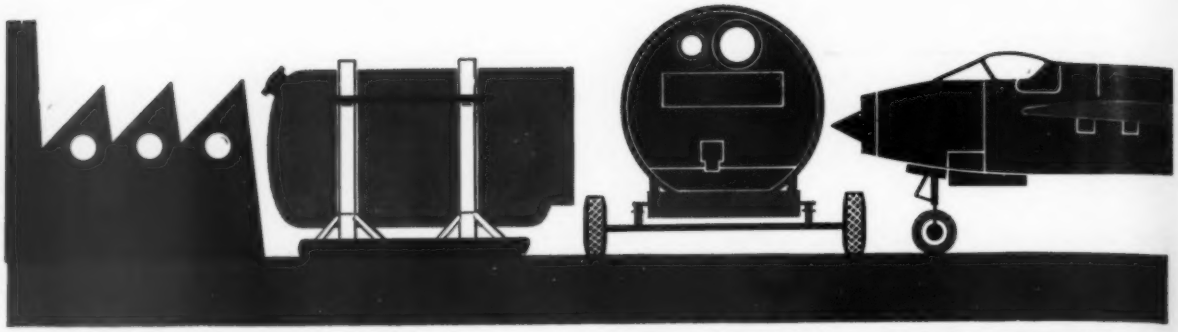


At the receiving end of calculated hustle: view from a cabin window of a Boeing 707 on the fuelling apron.

1615 on a winter's day at London Airport. A Boeing 707 of T.W.A. en route Frankfurt-New York receives fast Esso service.



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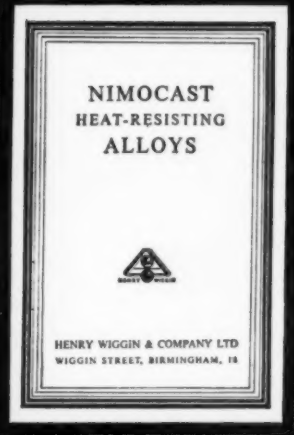

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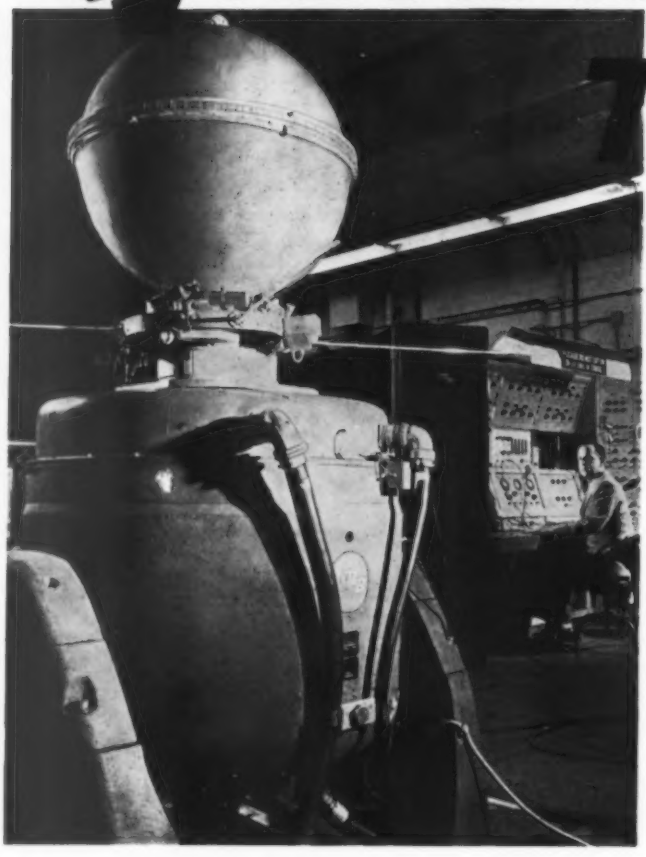

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Towards Fail-safe Air Traffic Control

BY CAPTAIN LINCOLN LEE

"Flight" photograph

THE first thing to be appreciated by anybody who has to deal with safety is that there is no such thing as infallibility. Mistakes will happen, and failures will occur. The fail-safe concept in aviation can be said to be an admission of this truism, coupled with the necessary action to prevent any single failure or mistake from being catastrophic.

This is hardly a new philosophy. Stone Age man doubtless carried a spare flint, and the motorist has always had his spare wheel. But in post-war civil aviation the philosophy has been taken to unprecedented lengths. Thus aircraft instruments are so designed that as far as possible they cannot give false information—they fail safe. Enough fuel is carried to allow for a diversion even when the weather forecast is good. Every vital system on the aircraft is duplicated, and those parts of the main structure which cannot be duplicated are stressed far in excess of any predicted load.

The application of such principles is obviously a matter of great expense; it probably more than doubles the cost of airline flying. The result, however, has more than justified the cost, in making airline flying as safe as other transport methods. But, by a paradox, although a single aircraft is carefully protected by fail-safe principles, two or more are not, for the air traffic control service, which is intended to keep them apart, takes virtually no account of fail-safe techniques. A study of those aerial collisions which have occurred, or of the near misses which occur at the rate of three a day over the USA, or approaching three a week over the UK, shows that all too often it is a single failure or mistake which causes the trouble.

For example, there was nearly disaster three years ago, when two aircraft almost had a head-on collision in an aerial corridor over southern England. One of them was flying level towards the east when the controller, an experienced and trusted man, in a moment of aberration allowed a westbound aircraft to climb through the other machine's flight level. It was a mistake which anyone might make; and perhaps because on this occasion it did not actually cause a catastrophe the lesson was not learned, so that a similar situation is likely to recur. Indeed, statistically it is certain to recur, and certain developments make each recurrence more and more likely to cause an accident.

What, then, is the lesson? In the writer's opinion it is this:—

ATC TECHNIQUES SHOULD BE AMENDED SO THAT FOR AS MUCH OF THE TIME AS POSSIBLE A SINGLE MISTAKE WILL NOT CAUSE A HAZARD

Corridor flying, and particularly two-directional corridor flying, should be avoided as far as practicable. This is, of course, a sweeping statement, for world-wide ATC is based largely on corridor flying, but the suggestion for its avoidance is not an entirely original thought. Many people in aviation have long considered that some ATC systems require radical re-thinking from first principles. The wide variety of aerial corridors and airways are now tending to create as many dangers as they remove.

At this stage two questions may well be asked. If corridor flying is a mistake, how did it come about in the first place? And why has it not caused more accidents?

It is difficult to give a short answer to the first question, but in the early days of ATC it was realized that aircraft must inevitably be sequenced on to the approach path to the runway. Thus, if several aircraft were flying from A to Z it was not unnatural to project such sequencing back from Z along the series of radio ranges or topographical features their captains were following. Hence the early airway in which aircraft flew to one side of the centre-line.

But to go back even further, before the days of ATC, when collision safety depended on random separation. Just as nowadays there are so few satellites orbiting the earth that the possibility of two colliding can be discounted, in a similar way random separation adequately protects a small number of aircraft. Indeed, as recently as 1956 *Aviation Age* published an article giving serious consideration to the abandonment of ATC over the Atlantic in favour of random separation. It can still be seen that the number of collisions and near misses in various areas of the world seems to bear more relation to the local density of aircraft than to the quality of local ATC.

We thus arrive at an answer to our second question: accidents due to ATC errors have been few, chiefly because inaccurate navigational aids have still allowed random separation on the airways. This is not as strange as it sounds. An airway controller visualizes his airway as a sort of channel along which move blocks of space which are often enormous. On a primitive airway, such as Cairo to Bahrain, each airspace block is many million times the size of the aircraft it protects. Even, therefore, it the controller makes a mistake and allows one block to telescope completely through another, the chances of collision are still remotely small.

This situation is now changing. Airways were sometimes fifty miles wide in the past, but some have now been narrowed to five nautical miles. Many modern aids, including Decca, Doppler and VOR, and their use in conjunction with autopilots, provide uncannily accurate track-keeping. This is particularly obvious to jet pilots, who nowadays often find their routes delineated both above and below by contrails only 2,000ft away. Thus even over a country like the UK, which possesses the highest-quality ATC service, the chances of a collision if the tenuous line of communication between pilot and controller is broken, or if either person makes a mistake, have begun to rise sharply. Visual collision avoidance is now becoming often impracticable.

The writer therefore offers the following suggestion:—

AIRCRAFT SHOULD, WHENEVER POSSIBLE, BE SEPARATED LATERALLY AS WELL AS VERTICALLY. IF THIS IS DONE ALONG THE ROUTE, AND WHILST HOLDING AWAITING CLEARANCE TO LAND, A SINGLE MISTAKE MAY NO LONGER JEOPARDIZE TWO AIRLINERS

Many improvements in ATC techniques have recently been given some publicity, and it is interesting to see how these can be related to the writer's suggestions.

Eurocontrol, as at present envisaged, merely faces up to the fact that the frontiers of small countries are impracticably close for efficient ATC. But its formation is a most encouraging step, because if aircraft are to be given adequate lateral separation it will be essential to have control of this sort covering a wide area.

Joint civil and military control—such as we are getting over the UK this year—is, in the opinion of many, a belated and half-hearted step. But if airliners are to be released from the confines of the airways, some sort of compromise with the military authorities will be necessary, and this joint control offers much promise.

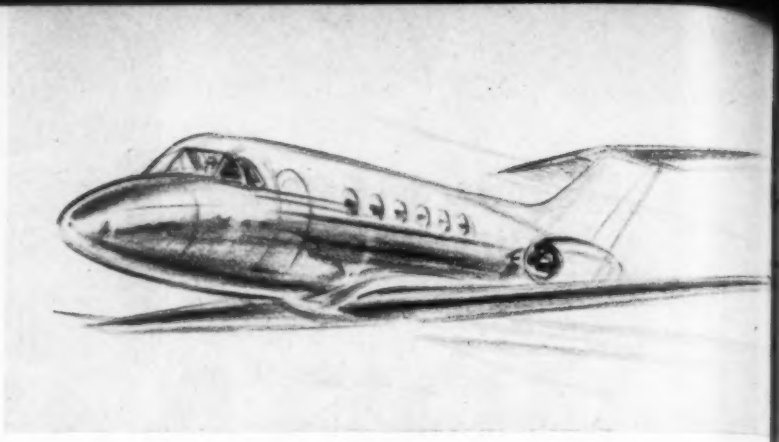
Primary radar, which it is claimed will soon cover almost the whole of Britain's upper airspace, has limitations and can be misused. A classic case of such misuse, if Press reports are correct, occurred last December, when a radar operator watched the New York collision on his screen but was unable to prevent it. Primary radar's many and varied limitations do not altogether detract from its basic value if they are understood. Certainly it has seldom been efficiently organized to prevent head-on collisions on two-way airways; but, if aircraft do leave airways and take advantage of the wide airspace on either side, it will become essential. So, for that matter, will secondary radar.

Automation also can be a dangerous weapon if misused. An ATC computer mishandled by a harassed controller may result in disaster being brought more quickly and efficiently. Provided that this risk is fully appreciated, however, automation will do a lot to hasten the introduction of fail-safe techniques.

Finally, "Operation Pathfinder," the experiment which began in the mid-western USA last autumn, but which has received little publicity. This was an upper-airspace experiment along the lines which the writer advocates, in which area control was tried out instead of the confining and potentially dangerous airways system. Early reports speak of it as having been as successful in practice as it is claimed to be in theory. It is fair to add that London Airways have for two or three years been using their excellent radar equipment to develop similar techniques in a small way within forty miles of London.

Footnote: Since this article was accepted for publication the writer has experienced precisely the sort of dangerous mistake envisaged in his article, though not in this part of the world. Another aircraft was given clearance by an approach control to descend through his flight-level, although at the time both aircraft were identical distances from the field and on the same VOR radial. The situation was saved because it was a clear night, and the pilot of the higher aircraft happened to see the collision light of the lower one.

JET DRAGON



de Havilland's DH 125 Executive Jet

ONE of the best-kept aviation secrets of recent months has been the date on which de Havilland would make available detailed information on their DH 125 executive jet, the existence of which has for many months past been known to those closely connected with the manufacturing industry or to business flying.

When it came, the first official release of news was scant indeed—an after-lunch reference to the project in February by Mr H. G. Sturgeon, de Havilland's managing director. He said that the DH 125 was occupying the thoughts of the company's project engineers and that a Dove customer was anxious to place an order.

No decision about production had then been taken, but the rumour persisted that metal had been cut and that production was soon to get under way. In April the basis of these rumours was confirmed. An illustration was released showing a neat little jet of 18,000lb maximum weight, with a wing of moderate sweep and with pods enclosing two Viper 20s nestling against the fuselage just forward of a high-set tail. Accompanying the drawing was information that an initial production batch of 30 aircraft was to be laid down, that the Hawker Siddeley investment was of several million pounds, and that DH considered that the type might well remain current for 20 years.

This week, in the fullest release of information to date, the name of the new aircraft is announced as the Jet Dragon, a deliberate association with the first twin-engine de Havilland transport, the DH 84 Dragon of 1932. In years to come the name may be abbreviated simply to Dragon, the qualification becoming needless once the aircraft and its capabilities become well known.

The day is passing when the executive jet is a perquisite of the millionaire few. In the USA, Sweden, Switzerland, Israel and Italy, and now in Great Britain, is rising a generation of new business transports with operating economics realistic enough to be compared with those of other tools of industry. On the basis of aircraft miles flown, de Havilland say, Jet Dragon costs will be almost the same as those for the Dove—about 2s 5d per aircraft mile.

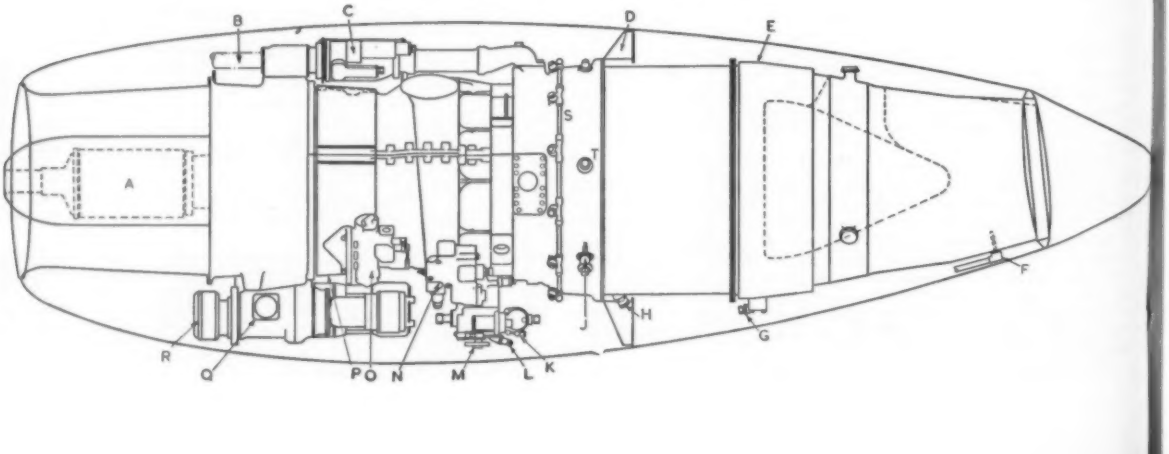
The economic argument for a jet as a business aid is that, in terms of seat miles flown per year, productivity is very much higher than that of a piston-engine counterpart. Thus, although the Jet Dragon may cost two-and-a-half times as much to operate per hour as the Dove (with which in capacity terms it is broadly comparable) its block speed over average stage-lengths of about 500 miles is greater in about the same ratio.

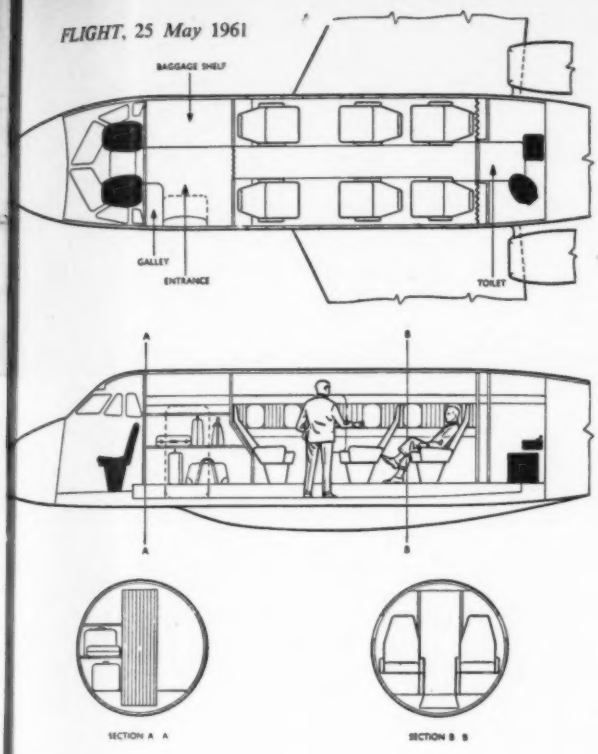
From this fact two points arise. First, for an annual commitment of say, 120,000 miles of business travel, the Jet Dragon's utilization would be 350hr compared to 800hr for a Dove operated at a similar total cost; and, because utilization in business use is limited by the degree of inconvenience which executives are prepared to accept, on such a high mileage the jet could provide a practical operation where a piston engine aircraft could not. Secondly, the economics of the jet are very much more critical in respect of stage-length, because stages of several hundred miles must be flown for operating cost per hour to be balanced or bettered by the greater return in miles of travelling. In practical terms this may mean that much more selective analysis may have to be employed by business firms contemplating jet operation, because the jet is less practical over the very short stages that represent a typical business-aircraft operation today.

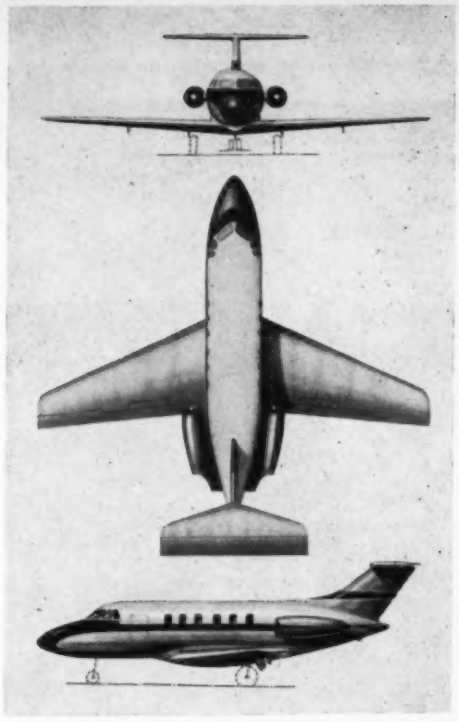
As projected, the Jet Dragon carries six passengers and baggage, in addition to the crew of two, over a range with reserves of about 1,500 miles. Cruising speed will be between 450 and 500 m.p.h. The aircraft is said to be capable of operation from short runways at moderate approach speeds, but no figures have yet been given. In the de Havilland tradition is the promise of "excellent handling characteristics at high and low speeds." The cabin, which has a wardrobe and toilet aft and entrance vestibule forward, is 18ft 6in long, 5ft 10in wide and 5ft 9in high. This is substantially larger than that of the Dove, or of the Beech Queen Air which forms the subject of a handling report in this issue. Air stairs can be supplied if required, but the vestibule floor is only 40in above ground level. Within the vestibule, space is available for a food and drink cabinet and a cupboard for coats and wardrobes. Cabin space is available for six executive armchairs and an aisle of generous width.

Advantage has been taken of the rearward position of the engines to produce a structurally uncompromised wing, built as a single unit from tip-to-tip and passing unbroken beneath the fuselage. A low aspect-ratio and relatively deep section contribute to stiffness and low weight. The top surface of the wing centre-section is dished to receive the cylindrical fuselage, and there is no abrupt discontinuity in either structure. Structurally advantageous, this arrangement also simplifies manufacture. All fuel is contained within the wings.

Bristol Siddeley Engines have won the contract for Dragon propulsion with the Viper 20 turbojet. In this drawing of a typical Viper 20 pod, the overall dimensions are: length, 103.5in; diameter, 32in; and the engine and complete nacelle respectively weigh 810 and 1,140lb. A, 6kW generator; B, lip anti-icing; C, anti-icing gate valve; D, firewall; E, turbine-blade containment shroud; F, thermocouples; G, drain; H, glowplug; J, igniter; K, pressure-differential switch; L, filter drain; M, l-p fuel filter; N, air/fuel-ratio control; O, flow control; P, compressor containment shroud; Q, tachometer; R, hydraulic pump; S, burners; T, primers







A typical Jet Dragon seating arrangement is shown in the views of the interior seen on the left. The cabin is larger than that of the Dove

As maximum cruising Mach number will not greatly exceed 0.7 flying controls will be manually operated. Flaps will be double-slotted and will be supplemented with air brakes. The cabin is pressurized, but the rear pressure-bulkhead is forward of the turbine discs. The position of the intakes it is claimed, is such that they are protected from stones thrown up from the runway.

Powerplants are Bristol Siddeley Viper 20s of 3,000lb thrust for take-off. First details of this more powerful variation of the Viper were given in *Flight* rather more than a year ago. A zero stage has been added to the compressor of the Viper 11 (Jet Provost T.4 engine), increasing thrust by about 500lb and reducing fuel consumption. Working temperature has also been reduced, so that the engine is conservatively rated and there is considerable development potential. Cruising specific fuel consumption is about 0.845.

No details other than those given above have been released concerning Jet Dragon performance or weights, and it is apparently the intention to withhold full information until construction is much further advanced. There will be no prototype aircraft, production following directly upon the design stage; de Havilland presumably have firm target dates of their own, but here again the only information that has been released is that deliveries will begin in 1963. This is the year in which the Swiss American Aviation Corporation will be in production with the Execujet, and Aero Commander Inc with the new four-to-six passenger Jet Commander 1121. First flight of the latter, which is to have a basic first cost of $475,000, is to be in April 1962. Powered by two General Electric CJ-610-1 engines of 2,850lb thrust for take-off, the Jet Commander has a maximum weight of 14,000lb and cruises at about 500 m.p.h. Other contenders in the executive-jet field are the North American Sabreliner, Heinkel-Potez CM-191, Israeli B-101-C, Saab 105 (*Flight*, April 20) and the Douglas-Piaggio Executive Jet (*Flight*, April 27).

What has been said so far lifts only a corner of the veil which surrounds de Havilland's new project. The aerodynamic similarity of the Jet Dragon to the Trident promises that many of the lessons that have been learned in developing that aeroplane may be applied to this jet successor to the Dove. It is reassuring also to know that the decision to go ahead follows a "long and detailed research" into market requirements, and as such may reflect the probable pattern of business aircraft operation over the next five years.

DH 125 JET DRAGON (two Bristol Siddeley Viper ASV.20 of 3,000lb thrust). *Dimensions:* Span, 44ft; length, 43.5ft; height, 14ft; wing area, 342 sq ft. *Weight:* Maximum, 18,000lb.

THE INDEPENDENT SPIRIT

A PLEA for greater competition from independent companies in the British air transport industry was made recently by Mr L. C. Hunting, president of the British Independent Air Transport Association, when he addressed the sixth Air Transport course organized by the Royal Aeronautical Society at Oriel College, Oxford.

"I believe there is room for further competition in the air," he said. "We are told that BEA has plenty to do to look after the foreign airlines coming into this country. It's a fact, however, that BEA is in a pool with every one of its competitors. I am not saying this is a bad thing, but it could equally well be argued that this is a negation of true competition."

He said that competition on routes such as London - Paris should be less closely controlled, and added: "I don't believe the public would suffer—and, after all, it's the public we are concerned with in all of this." Even if a new company went bankrupt after a few years it would have "shaken up" the industry.

Speaking of the difficulty of getting on to established routes, Mr Hunting cited the agreement between Qantas, Air-India and BOAC over the Far Eastern run. He also said that while there was no legal impediment to operating a shipping line across the Atlantic the same was not the case with air transport.

BIATA was virtually a trade association which represented over 90 per cent of the independent companies in this country, outside the two corporations BOAC and BEA. It existed for three main reasons: to make a profit, to give service, and to create and maintain a reasonable level of employment in the industry.

The 69 independent companies which operated just after the war had now shrunk to about 20, not all of which were members of BIATA, and the process of amalgamation and take-over was likely to continue. But the right to enter the industry should not be denied to those companies which "from absolutely nothing came up the line."

Mr Hunting went on to say he did not believe the BIATA was skimming the cream off the corporations' traffic, but rather were taking the crumbs from their table.

Basically, the question of running air transport was a matter of politics—whether it should be entirely under the State, entirely under private enterprise, a combination of the two as in Britain, or run by outside countries, as was the case in small countries like Luxembourg. Of the British system he said: "However good they are, it seems to me that the corporations cannot be 100 per cent good 100 per cent of the time. I think this is where independence comes in." BIATA could offer alternative employment in the industry, provide fresh thinking and act as a testing ground for new ideas.

"We offer an alternative market for the aircraft industry," added Mr Hunting, "and we are there if the British manufacturer wishes to test out an idea which he knows has no chance of being accepted by the corporations."

QUEEN AIR in the Air

BY ALASTAIR PUGH

No 147 of the series

FOR some months past Mark Lambert and I have been wanting to get our hands on a Beech Queen Air. We nearly managed it in November, just before flooding put a temporary halt to our winter-flying activities from the *Flight* Gemini's home base at Fair Oaks; but sustained crosswinds at Belfast then made the journey to the UK agents, Short Brothers and Harland, impracticable. The Queen Air has since visited Rochester for short periods and various examples have been seen elsewhere in England, but the type eluded us until the Shackleton sales weekend at Coventry, where it was much in demand for demonstrations.

In spite of this Shorts very generously made the aircraft available for a whole morning, with a thoroughness that seems typical of their approach to the business of selling light aircraft. As a company, they probably knew more about aeroplanes before the First World War than some other distributors know 16 years after the second, and since the first Queen Air arrived at Belfast six months ago, the Light Aircraft Division have been very busy carrying out a complete structural and aerodynamic evaluation.

For a basic price of £54,630 (duty paid) a prospective owner may reasonably be particular about cabin comfort and furnishings, and expect comprehensive standard equipment. Although the six- or seven-seat cabin may be thought a mite on the tight side, the Queen Air provides few disappointments in these respects, and the really thorough standard of equipment and utility is extended forward of the sliding doors to the pilot's cockpit, on which much detail design thought has obviously been lavished.

ILLUSTRATED WITH "FLIGHT" PHOTOGRAPHS

Though business aeroplanes in this class are generally flown by professional pilots, great skill and experience are not demanded of those who fly the Queen Air. After a couple of hours of flying it myself, or standing between the pilots' seats watching it being flown, I came to appreciate it as a pilot's aeroplane, with the generally pleasant handling characteristics that are to be found in all the Beech range. No private pilot need be daunted by the 680 h.p. of its two Lycoming IGSO-480-A1A6s or the total weight of 7,770lb, and the cockpit is so laid out that one man can easily manage the aircraft by himself. Though tough and fast the Queen Air is not aggressive.

There is plenty of room to enter either seat, which adjusts in as many ways as a dentist's chair. A cross-bar under the left of each cushion controls vertical position, fore-and-aft locks being engaged by a similar arrangement on the right. The central elbow-rest also folds, and squab and seat are both very comfortable.

First to arrest the eye is an enormous black-painted radio and navaid display bang in the middle of the panel, easy to see and easy to reach. Equipment in the demonstrator included a 360-channel Collins VHF radio, 190-channel receiver and omni converter, a stand-by transceiver, ILS glide slope; Sunair HF; Wilcox ADF, and marker-beacon receiver (nine different packages are suggested by Beech). Below this is a small console on which are mounted quadrant-type throttle and propeller controls, trim wheels and window indicators for all three control axes and an extension bracket for the controls and the altitude, VOR and ILS locks of the Lear L-2 autopilot.

Included among the blind-flying instruments on G-ARFF, the Short demonstrator, is the 3in scope of a variable-inclination RCA weather-radar, and an RMI. The a.s.i. has the usual white, green and yellow sector lines and is red-lined at a VNE of 270 m.p.h. A full or part selection of repeat blind-flying instruments can be installed to the right of the radio display, the big panel only then becoming really full. Engine information is concentrated into five instruments set side-by-side under the padded coaming: double-needle manifold pressure and r.p.m. gauges, a combined oil temperature, oil-and-fuel-pressure instrument for each engine, and a single, fifth instrument-face on which is recorded cylinder head temperatures.

Notwithstanding this array, engine handling is simple. An automatic control renders computers and such-like unnecessary. Should fuel pressure edge below the green sector it can be restored by switching on the fuel booster pump. There are no cowling gills and even at high powers and low forward speed Shorts have found that temperatures remain within the green. A warm-air control is provided, but this is only required in conditions where there is a possibility of ice accumulating in the intakes. Miniature enrichment switches on the console for restoring power in high-altitude conditions are automatically cancelled by fingers on the throttle levers when the latter are closed. Except in one respect, recounted later, handling of the Queen Air's two supercharged, fuel-injection engines requires less attention than do some singles.

Fuel system management is made particularly easy, tank gauges and selectors, boost pumps and cross-feed switches all being contained in a neat diagrammatic panel on the cockpit wall alongside the pilot. Tank contents, placarded a bit pedantically as 36.66 Imp gal mains and 59.16 auxiliaries, are recorded both on the fuel panel and again on the main panel for the second pilot. Tank purging is included.

De-icing, the starter system, and sundry other instruments, controls and circuit breakers, occupy the black-painted sub-panels each side of the console. A key-switch puts all the electrics out of circuit when the aircraft is unoccupied. On the carpeted cockpit floor are oil shut-off cocks, a handle for emergency undercarriage retraction, and flush-mounted circuit-breaker buttons protecting the all-electric flap and undercarriage circuits. Roof-mounted lighting switches are the only controls elsewhere; nothing is tucked away above or behind the seats. The action of all minor controls is also very pleasant.

Quite a sequence of switching precedes engine starting—battery and generator switches on, key master-switch on, magneto switches on, idle cut-off switches off, engine start-selector switch left or right, boost pumps on. Then the red cover guarding the diminutive starter and primer buttons is raised and the engine turned over by the one and fed with fuel by the other. Both Lycomings started smoothly and idled with a muffled whirr at about 1,200 r.p.m. exhaust noise being heavily suppressed from within the cockpit.

With the seat raised, view for taxying was good; the windscreen frames are fairly heavy and the wipers cannot be parked out of sight, but the nose falls steeply away from the window panels and I could see about a third of the port tailplane. With quite light nosewheel steering and progressive toe brakes, taxying is easy. Differential power is not needed. Although the Queen Air's fuselage is about the same size as that of a Dove, the span is only 9ft greater than an Auster, an obvious advantage in confined spaces.

For take-off there is one important limitation—boost must not be allowed to exceed 48in Hg, as will happen if the throttles are opened fully. So that I could keep my eyes on the runway ahead, Ken Dunlop, the Short demonstration pilot, restrained the levers; but later, when we were both concentrating on a touch-and-go on the grass between Baginton's radar scanner on our left and a Leopard Moth touching down on our right, I was thoroughly caught out. Anxious to get airborne again I opened the throttle wide—a conditioned reflex of any pilot who usually flies behind a normally-aspirated engine. The danger is that an overboosted engine will lose power. Dunlop, very much on the ball, was quickly there with a checking hand, but the limitation is an awkward one.

Pretty miserable weather kept us intermittently on instruments for the next half hour. I found the wheel forces a good deal higher than those of the smaller models in the Beech range, particularly noticeable in turns being the increasing elevator load with g. On the ground, the wheel rests against its forward stop and is, I

only the helicopter

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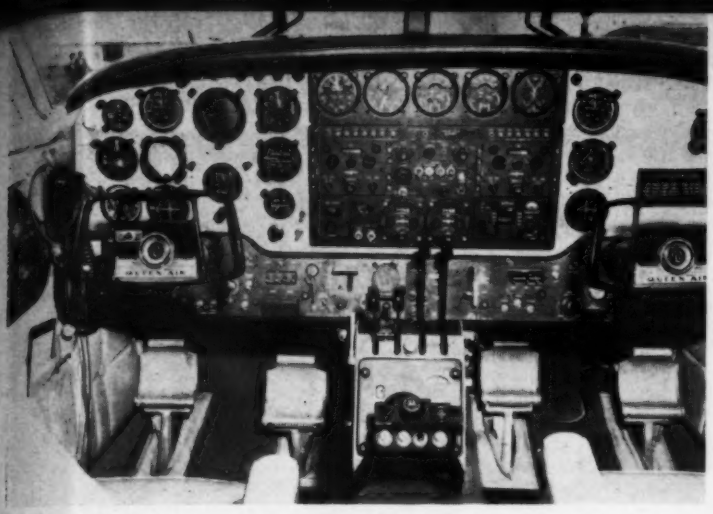
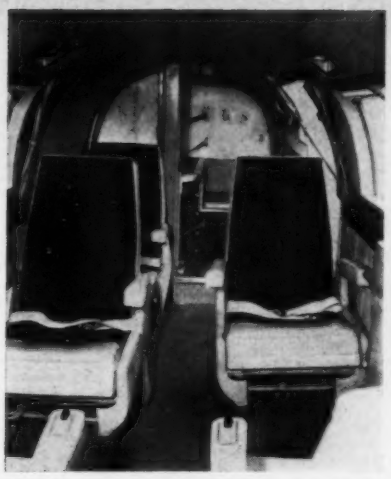




Two features of the Queen Air cockpit stand out above all others: the large central radio panel and the simple engine controls, the latter a bonus from automatic fuel-injection. Other good points are the schematic fuel-system panel on the extreme left, big rudder pedals, and the three-axis Lear autopilot on the console. The cabin (right) is upholstered in a range of pleasant materials the like of which are rarely seen in this country. A curtain conceals the toilet aft of the entry door.

QUEEN AIR in the Air . . .

imagine, spring loaded into this position. The bias is sufficiently strong to overcome noticeable friction in the elevator circuit. I found the Queen Air rather difficult to trim; after apparently getting settled, it would drift away again, calling for frequent fine adjustment of the trim wheel. This operates a circuit which is apparently most effective, but on and off I chased attitude changes without becoming fully stabilized.

Elevator forces harmonized well with those of rudder and aileron. The rudder is barely required in turns of up to 30° bank, which may be conducted "ball-in-the-middle" on wheel control alone. Ailerons were pleasantly light and their response good, although the control was not particularly powerful; there was a small frictional dead zone in the centre of the travel. The overall control effect is what one might expect of a little airliner, a description which the Queen Air fits well.

Even at low altitude the aircraft cracks along. After climbing at maximum power to just under airways height, I reduced to 32in and 2,300 r.p.m. and recorded 175 m.p.h. Noise level is very moderate, although the subdued growl suggests that outside the cabin there might be a much sharper bark. At 2,750 r.p.m. and 30½in boost—about right for 65 per cent power—indicated airspeed was 169 m.p.h. Some measurements by Shorts indicate that at 70 per cent power at 10,000ft, true cruising speed is about 203 m.p.h.

If the Queen Air exhibited typical light transport characteristics during cruising flight, its behaviour at the stall was akin to that of a Piper Cub. Nothing could have been more innocuous. As I reduced speed slowly the undercarriage horn began a repetitive bleat, the red stall warning light glowed at 90 m.p.h. and somewhere between 80 and 84 m.p.h., without any noticeable buffet, the nose dropped cleanly away. There was no wing drop and I recovered after losing only about 150ft. Hauling back hard on the elevator as the stall approached brought considerable aerodynamic buffet and the stall itself was more sharply defined. But again there was no trace of wing drop and quite coarse aileron would not provoke it.

Next I lowered the undercarriage with the knob to the right of the console, and inched down the flap to its full 40° deflection with the lever on the port side of the lower panel. Actuation of both services is electric. The flap shows a slight tendency to overshoot the selected position, indicated by a panel instrument graduated in percentages, but there was no associated trim change, nor was there one with undercarriage actuation. I found the flap lever a shade too close to the panel for complete comfort. Stalls in the "all-down" configuration were just as gentle as they were clean, breakaway occurring at 75 m.p.h. following artificial warning at 82 m.p.h.

A spot check at cruising power showed the Queen Air to be positively stable in yaw, neutrally stable laterally and stable in pitch although longitudinal damping is not very marked. Three distinct oscillations accompanied by wing drop either way followed a 10 m.p.h. (6 per cent) speed increase from 170 m.p.h.

Searching around for a patch of clear air I settled down again, and asked Ken Dunlop to cut and feather an engine. The autopilot, incidentally, is first rate and with its approach and altitude locks and turn-and-pitch controls is just the job for IFR flying when a single pilot is busy with navigation. It is tripped out by a thumb button on the wheel.

In this day and age when an engine on a businessman's twin can be feathered at the price of only a few pounds of out-of-trim foot load, the Queen Air is almost unusual in requiring a heavy bootful of rudder; unprepared for this, I was 10° or 15° off course before I had checked the swing. With changes of power one then becomes busy relieving rudder and wheel forces; pitch trim changes with power, presumably as a result of spring-loading the elevator, are marked. Rudder trim is effected by thumbing the rim of a wheel, the axis of which is set vertically into the console; without glancing down at it I found its action rather confusing. Nor is it very easy to see the rudder trim indicator.

Minimum control speed occurs at about 95 m.p.h. with the stall warning light just beginning to flick on. There is adequate rudder trim in this condition and also with the live engine at take-off power of 3,500 r.p.m. and 46in boost. In the latter case the tab is against its stop but there is no residual foot-load. Four up, and with about half fuel, the Queen Air climbed at an indicated 150ft/min with cruising power on the live engine, and at 350ft/min at take-off power and 117 m.p.h., when turns in either direction could be made without difficulty. Control loads lightened off at these low speeds but control sensitiveness was not impaired.

BEECHCRAFT M65 QUEEN AIR

Two 340 h.p. Lycoming IGSO-480-A1A6

Dimensions: Span, 45ft 10.5in; length 33ft 4in; height 14ft 2in.
Weight: Max 7,700lb; empty 4,740lb; useful load, 2,960lb.
Payload Accommodation: Cabin length, 9ft 4in, height, 4ft 9in; width, 4ft 6in; max passenger seats, 7.
Performance: Cruise at 70 per cent power, 15,200ft, 214 m.p.h.; at 65 per cent power, 10,000ft, 200 m.p.h.; fuel consumption at 65 per cent power 36 US gal/h; max single-engine rate of climb, SL, at max weight, 245ft/min; take-off distance to 50ft, 1,660ft; range with full fuel, with reserves, 1,010 miles at 5,000ft, 70 per cent power, 1,220 miles at 45 per cent power, 5,000ft.

We had now been flying out of contact for over an hour and a quick QDM brought us in over Baginton to join the 200-odd other light aircraft on the ground or around the circuit. Under these conditions, the good visibility was most welcome, but I was glad to shed some speed by lowering the undercarriage just below the maximum of 150 m.p.h. and progressively slip-down flaps below 130 around a necessarily restricted circuit. By light-aircraft standards the approach speed of 110 m.p.h. for finals and 105 m.p.h. over the hedge is fairly fast, but it does not feel so, and here the Queen Air seems to hold its trimmed speed to a hairline. There is plenty of elevator at low speeds but apparently not much cushioning ground effect, and we rolled on reasonably smoothly just before I expected it at about an indicated 96 m.p.h.

Executive aeroplanes in the Queen Air class are now so refined that criticism of them is justifiable wherever cause can be found. My main impression of the Queen Air is that of a fast, very comfortable twin with obvious potential for business travel in any weather. This particular aircraft exhibited more control-circuit friction than I would have expected and its rather marginal pitch and roll stability gave rise to a mental query about its handling in rough-weather IMC, which I did not sample. Not that a business pilot would be concerned on 99 per cent of his flights—he can tune the VOR, plug in the autopilot, switch on the weather radar, lower the seat, light a cigarette and get on with the job of flying, on time, to wherever the aircraft is needed. I rather envy him.

Straight and Level

"CHAOS AS THE BOARD MEETS," ran the headline in the *Daily Mail* last week. The air correspondent's story-angle was not about the Cunard Eagle case itself, but about "airline executives, public and Pressmen milling about the doors of a tiny boardroom in the City of London, struggling to get in to the inquiry held by the new Air Transport Licensing Board."

The court room certainly was packed, but I wouldn't exactly say that it is tiny. The problem is an air transport problem: how do you meet peak demands without providing excess capacity in off peaks? At most of the Board's hearings there are barely more than half a dozen seats filled—a load factor of about 6 per cent. The story-angle then, I suppose, would be that the Board's new premises are an extravagant waste of public money.

Perhaps we ought to have an inflatable elastic court room which can be expanded, at small cost, to accommodate the important people who attend Board meetings only at peak times.

● I hoped in vain that our airlines would not brief counsel to advocate their cases before the Air Transport Licensing Board. It will be a pity if proceedings become mannered legalistic wrangles. At one stage, I know, the corporations and some of the independents discussed a sort of informal agreement not to hire legal mercenaries to fight their battles. But it was not to be: BOAC, BEA and BUA have all retained distinguished QCs, and only Cunard Eagle are fighting with their own troops.

One disadvantage of hiring counsel is that the limit of their air transport knowledge is the limit of their brief. This was evident during the Cunard Eagle North Atlantic hearings last week. For example, BOAC were made to look rather foolish because their counsel, Mr Henry Fisher, QC (barrister son of the Archbishop of Canterbury), said he had not heard of a publication produced by Cunard Eagle. The document concerned, United Research Inc's *Competition Among United States International Air Carriers*, is well known in the business, and of course a lot of people in BOAC must have read it. If they had been represented by one of their own troops, they would not have had to admit ignorance, but would have countered that the document concerned treats of American second-thoughts about two airlines on a route, rather than being an argument for "dual participation," as Cunard Eagle seemed to be suggesting.

* * *

But everyone had a good laugh—including Cunard Eagle—when Mr Ashton Hill said that he would not read out the whole of this particular document, but would "go straight to its summary and confusions . . ."

● You must read the June issue of the *British Air Power Gazette*. In it Dr Otto Norm, the well-known air transport economist, has published a paper entitled *A New Approach to the Estimation of the Direct Operating Costs of Transport Aeroplanes*.

I think it is the definitive statement on this highly controversial topic. It is a masterly work of scholarship in a field that has sorely needed the fresh and original research that Dr Norm always brings to a subject.

Not everyone will agree with his suggestion that seating capacity has no bearing on cost per seat-mile, and that first cost, depreciation life, basic weight, speed and fuel consumption are "overrated parameters in socio-economic aircraft costing viability postures." But there will be universal agreement with his suggestion that these parameters be replaced by two new constant variables: (1) creep life of the turbine blades × nosewheel steering angle, and (2) elevator trim motor r.p.m. × the square root of the elevator's Reid Vapour Pressure.

Novel suggestions, perhaps. But if you doubt the validity of Dr Norm's work you have only to glance at the 42 graphs. They all have genuine Fig numbers, and look really impressive and technical.

● One more thing on the Licensing Board—BOAC's counsel pressed Sir John Brocklebank, Cunard's chairman, to agree that "Cunard want to back two horses, the aeroplane with their own money and the ship with other people's."

I liked the quotation that came up in the recent House of Commons debate on the Government's subsidy for the new Cunard Queen liner: "If you can't ride two horses at the same time, you shouldn't be in the damned circus anyway."

ROGER BACON

In 1914 a young American called Billy Parker built himself a pusher biplane, Glenn Curtiss style. In 1961, he turned up with it at Moffet Field, near San Francisco, to join in the US Navy's celebrations of a half century of US naval aviation. Here he is, impeccably hatted for the occasion (he also wears an RFC tie), with Cdr Hal Ewing, USN, and Lt Ben Elliott just before having a closed-circuit handicap race with them in their 1,500 m.p.h. F4H Phantom II. Capt Parker finished first but, after some banter about corner-cutting, the judges declared "no decision." (1961 technical note: Lt Elliott is connected to his suit refrigerator)

Left a bit, right a bit, steady, whoa! Who said the JAP Blériot-type aeroplane of 1910 was difficult to handle in the air, even without wings? The trepid aviator waxes indignant at the very suggestion. He is on his way to eternal hangarage in the new extension block at the Science Museum in South Kensington

FLIGHT SYSTEM SURVEY

Burndept's Light Aircraft Radio

PRODUCTION of a batch of 100 Burndept five-channel VHF radios for light aircraft is now under way and a number of sets have been sold. The equipment is approved by the MoA in Class 2. Either BE.255 panel-mounted or BE.256 remote-mounted versions are offered, each with a built-in transistorized power unit which can be set for 12V or 24V. The radio can be used with or without a small control box providing jack points and volume control.

Five pairs of crystals for frequencies between 116 and 132 Mc/s are plugged into a board behind a hinged, spring-clipped cover on the front of the radio so that frequencies can be easily changed in flight. Fine tuning is achieved by pressing the transmit switch and tuning until a luminous indicator shows minimum separation between lighted areas. The radio can be operated from the aircraft electrical system or will run for seven hours from a 12V, 24Ahr battery. Transmitter range is stated to be 50 miles from 3,000ft, but much better performance has on occasions been recorded.

During a recent *Flight* trial in an Auster from Eastleigh, the equipment proved very easy and quick to operate and gave good, clear speech quality. Fitted on its mounting tray, the radio measures 8½in × 4⅞in × 11½in deep and weighs 8lb 2oz; the control box weighs 10oz. Cable connectors are provided, but choice of a headset of 150 Ohm impedance, and of a 300 Ohm electro-magnetic microphone, is left to the customer. For servicing and repair the sub-chassis can be readily extracted from the case, and the receiver set up on a bench with the transmitter/modulator unit.

The BE.255 radio, connector kit and control box cost £136 7s 6d; pairs of crystals cost £3 5s each, mounting tray £4 15s and aerial £4 15s. The BE.256 with remote control box and 5ft flexible remote tuning control costs £167 10s.

Burndept are reported to be planning a miniaturized version of the BE.255 which would be about half the present size; and they may also produce a simple VOR attachment.

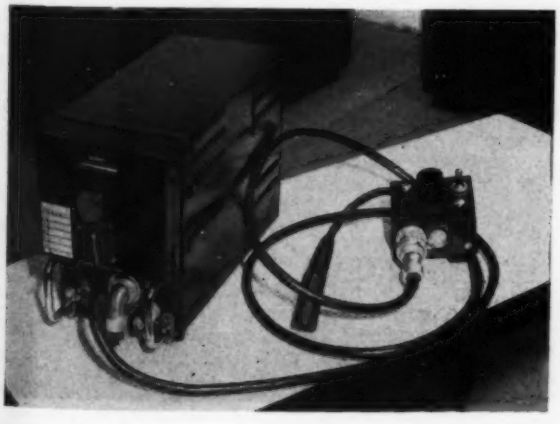
Smiths FAA Contract on Schedule

FOLLOWING a report in these columns that the FAA programme to evaluate automatic landing equipment in a DC-7 was considerably behind schedule, Smiths have stated that their work in conjunction with Sperry in New York is following a joint timetable agreed at the start of the project and that it is going according to plan.

Photographic Flight-path Tracking

FIRST overseas demonstration of the Fairchild photographic flight analyser took place recently at Cranfield. The equipment employs a manually rotated viewing assembly, fitted with sighting binoculars. As it is turned, this assembly trips an electric high-speed shutter to take successive photographs through a special fixed 93°-aperture lens on a flat photographic plate. Timing marks produced by a vibrator-controlled relative timer are photographed through a separate lens and coupled shutter to appear at the foot of each vertical picture strip. The complete plate, bearing 58 images side-by-side, can then be developed and several copies printed, if necessary, to allow rapid analysis. Because a fixed lens and flat plate are used, perspective effects are eliminated and very few corrections have to be applied before effective information can be derived. Because the equipment is tripod-mounted and operates from six 6V batteries, it is sufficiently mobile to be moved rapidly from one site to another. Accuracy is sufficient to determine the speed of the observed vehicle to within 1 m.p.h. and accelerations of as little as 0.5ft/sec/sec.

The tracking binoculars are marked with parallel hairlines to indicate the width of each frame on the plate. Balance weights at the end of stabilizer arms facilitate steady tracking. For a certain angular movement before and after the camera operates, the shutter is not tripped and the operator can steady his rate of tracking. The equipment can also be set up at an angle to track steeply inclined trajectories; and groups of flight analysers can be set up to derive three-dimensional flight-path co-ordinates. Agencies in the USA already using the analyser include the US Army Signal Corps Drone Test Facility, USAF Edwards AFB, Grumman Aircraft and the National Aeronautics and Space Administration. Fairchild Camera and Instrument Corporation is represented in England by Aveley Electric Ltd, South Ockenden, Essex.



Burndept BE.255 light aircraft five-channel VHF radio, production of which is now under way (see item above)

A block of five Electronic Associates PACE 231R analogue computers being prepared for delivery to NASA at Langley Field, Virginia

Doppler Orders

IT has been announced by Canadian Marconi Co that the USAF has issued a military type number to the CMC Doppler radar and that an order worth $1.5m has been placed for equipment to be installed in USAF Lockheed C-130Es. The Canadian Doppler has already been ordered for installation in USAF Grumman Albatross rescue amphibians. USAF evaluation began in July last year.

Seven civil airlines have ordered the Canadian Doppler for installation in their jet transports.

Bendix now have $12m of orders for their Doppler radar and for the Computing Devices of Canada PHI dead-reckoning computer. Bendix Doppler worth $2.5m is already installed in Fiat-built G.91s now in service. The German Government and Fiat, under MWDP, have ordered a large quantity of integrated Doppler and PHI navigation systems to be installed in both Fiat-built and German-built G.91s; and Lockheed F-104Gs are also to be so fitted. This brings the number of PHIs sold to more than 700 and the number of Bendix Dopplers ordered to more than 600.

Analogue Computer Sales

THE United Kingdom Computation Centre has been set up by Electronic Associates Ltd, subsidiary of Electronic Associates Inc, at their Burgess Hill factory. Nuclear, automotive, missile, chemical and shipbuilding companies will be able to rent time on a PACE 231R computer with 80 operational amplifiers and detachable patching panels or on a TR-10 transistorized desk-top computer with 20 amplifiers. There will be facilities for complete problem preparation, with or without assistance, and the extensive problem libraries of centres at Princeton, Los Angeles and Brussels will be available.

The Eindhoven Institute of Technology has bought a PACE 231R computer with 60 amplifiers and related non-linear equipment from the American company. Folland Aircraft are to acquire a PACE 221R and Vickers-Armstrongs have ordered a PACE 231R for research in connection with the TSR.2.

A computer system involving five separate PACE 231R computers occupying 1,800 sq ft of floor is also being completed under a $1,500,000 contract from NASA's Langley Field. The installation is illustrated above.

Sport and Business

Mechanics of the Air Services Division of Pressed Steel Co at Kidlington preparing one of the College of Air Training Piper Apaches for validation of the American C of A. The Division is also responsible for after-sales service for Beagle aircraft

GLAMORGAN FLYING CLUB is sponsoring the 1961 International Welsh Air Rally in connection with the London - Cardiff Air Race and the short-circuit national air races at Rhoose on June 2-3. The London - Cardiff race will end at Rhoose on Friday afternoon, June 2; the following day's programme will include course practice for the short-circuit races in the morning and a general flying display in the afternoon.

THE AVIAN TROPHY and £200 prize money will be awarded on the results of the Bristol Air Race, to be held on June 24 at Bristol (Lulsgate) Airport during the Bristol Air Day. The race is open to any type of aircraft entered by an individual or company, subject to a gross-weight limitation of 12,500lb, and detailed regulations are available from Bristol Corporation. The air day programme includes flying displays by the aircraft of the RAF and USAF, and by the Bristol Fighter, Bristol Bulldog and Gloster Gladiator.

A NEW TWIN-ENGINED CESSNA, the Skyknight, is now flying and is expected to be available for first deliveries in August. Powered by two 260 h.p. turbo-supercharged Continental engines, the Skyknight will carry five persons and will have available the full power of its engines to a height of 16,000ft. The new machine has been under development for several years and will be the highest-performance type among the 1962 Cessnas. The company state that the aircraft will be capable of speeds up to 265 m.p.h. at 16,000ft, and capable of operating at altitudes over 27,000ft.

THE JEAN LENNOX BIRD TROPHY for 1960 was presented on May 4 by Lord Brabazon to Miss Sheila Scott. The selection panel for the trophy, which is sponsored by the British Women Pilots' Association and is awarded each year to a British woman pilot for a noteworthy achievement in aviation, stated: "During the first year after obtaining her Private Pilot's Licence, Miss Scott flew more than 300 hours and she participated in a large number of rallies, tours, air races and competitions."

ULSTER FLYING CLUB, the only private flying club in Northern Ireland, officially closed on April 30, but an attempt is being made to re-form it. Since its formation in 1952 the club has been managed and operated by Short Brothers & Harland, who provided a substantial subsidy. Earlier this year, however, the firm decided that the cost of the club's activities could no longer be justified, and withdrew its support.

Now a committee formed of club members has appealed for 100 air-minded Ulster people to join and guarantee to support the club, and already 40 people have accepted. When the required number have joined, a limited-liability company will be formed. The committee hope that flying will be resumed by June, when two new Piper Colt aircraft and a Tiger Moth will be used. Flying costs per hour will be £4 17s 6d for the Colts and £3 17s 6d for the Tiger Moth. It is felt that a pilot should reach solo stage in a much shorter time on a Colt than on previous club aircraft, so that PPL costs should not be any greater.

THE SLINGSBY T.49 two-seat sailplane is to be known as the Slingsby Capstan. The first production model is to be presented to the British Gliding Association by the firm of W. D. & H. O. Wills.

Mr C. L. Pashley, manager and CFI of Southern Aero Club, who (as reported in "Flight" last week) receives the Award of Merit of the Guild of Air Pilots and Air Navigators. At 70 years of age he has been flying for 50 years, and continues to do so regularly

British and American examples of cockpit-panel layout: left, the Beagle-Auster Airedale, subject of a full description in "Flight" of May 4; right, the Piper Cherokee, AutoFlite model. In the Cherokee all flight instruments, including full gyro panel, are on the left, with radio equipment in the centre and engine instruments on the right. Standard radio equipment comprises Piper AutoNav radio compass (top) and Narco Superhomer providing two-way VHF communication and omni-navigation

DART Herald

Pressurised civil or military jet-prop transports; 56 passengers or 6½ tons of freight or combinations of both at 275 m.p.h. for 850 miles; operates from 1000-yd. grass airstrips; built for long life and easy maintenance; penny-a-passenger-mile economy.

"This dropping zone was barely a backyard

. . . attached to a little ring of huts perched right on top of a hill—completely surrounded by a bowl of 10,000 ft. mountains. A sharp turn had to be made immediately on passing the dropping zone to climb up out of the bowl. It felt as though we were brushing the treetops on the mountainside as we flew round in a 45°-bank turn at 110 knots for a second run. However, the Herald coped. . . ."

So ran the pilot's report of a supply-drop by Dart Herald in the Naga Hills of Assam. Such challenging tests have demonstrated the aircraft's versatility and strength during its see-it-in-action proving flights of nearly 200,000 miles around the world to 56 widely-differing countries.

Heralds are built by Handley Page to fly; to fly strongly and safely with power to spare. They are making light work of some of the most difficult flying conditions and airstrips to be found anywhere.

Their fail-safe design, craftsmanship and Rolls-Royce Dart engines are guarantees of economy, versatility and safety.

Now at Handley Page's factories around London, production is apace on a first batch of 25 Heralds for service with Jersey Airlines, Maritime Central Airways, British European Airways, North-South, Nordair and other operators.

HANDLEY PAGE RADLETT LONDON READING

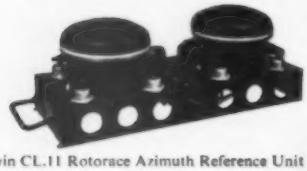
SPERRY answers Aviation's need

Air Speed Indicator

Roller-blind Director/Horizon

Machmeter

Vertical Speed Indicator



Twin CL.11 Rotorace Azimuth Reference Unit

VGL.2 Attitude Reference Unit

Sperry Gyros form the heart of the Trident's attitude display system. CL.11 Rotorace Directional Gyros provide the azimuth references; VGL.2 Vertical Gyros supply precise attitude information to the roller-blind director/horizons designed for de Havilland's new jetliner. Sperry also manufacture the Trident's Air Speed Indicators, Vertical Speed Indicators and Machmeters.

Altogether the Sperry Team is contributing 18 functional instruments to the overall Smiths/Sperry consortium project.

The Trident is one of many important aspects of Sperry's aeronautical work. The company is currently engaged on navigation, guidance, and control problems for VTOL and Helicopters, as well as fixed-wing aircraft: these offer long-term interest to electronic and electro-mechanical engineers and designers, on stable platforms, auto-stabilizers, auto-pilots and instrumentation. If you feel you would like to play a part in

solving tomorrow's problems today

SPERRY

. . . we invite you to discuss your place in projects of this nature at any of the Sperry establishments with KEITH STONEMAN, BRACKNELL. Tel: 1301

SPERRY Gyroscope Company Limited

BRENTFORD (Middx.) BRACKNELL (Berks.)

"Exhaustive analysis" of data recorded during a Convair 990 test flight on May 8 enables the manufacturers to claim that Mach 0.97 was achieved at 22,500ft. Convair have been testing the design change that followed wing flutter at high speed ("Flight," March 30, page 420). The aircraft has also been flown at 426kt IAS at 14,000ft. The "fix"—accomplished and evaluated remarkably quickly—is evident from the lower picture, which shows how the outboard pod has been shortened by 28in. Certification and airline service of the 990 are due in December, with preliminary deliveries to American, Swissair, SAS and REAL in October

AIR COMMERCE

The Board has a Secret Session

THESE pages go to press as the Air Transport Licensing Board opens its hearings into the Cunard Eagle Airways application, opposed by BOAC, for a North Atlantic route. A preliminary report on this important case begins on page 723. The note here reviews other recent Board meetings; though issues were less momentous, points of principle arose.

A NUMBER of points of principle have emerged from recent hearings of the Air Transport Licensing Board. The cases concerned were relatively uncontroversial—inclusive tours being applied for by independents. At one hearing, on May 5, Tyne-Tees Air Charter of Newcastle put their case for an E licence to enable them to do charters throughout Europe and the Mediterranean without having to make constant reference to the Board. Skyways objected that the scope of the application was too wide.

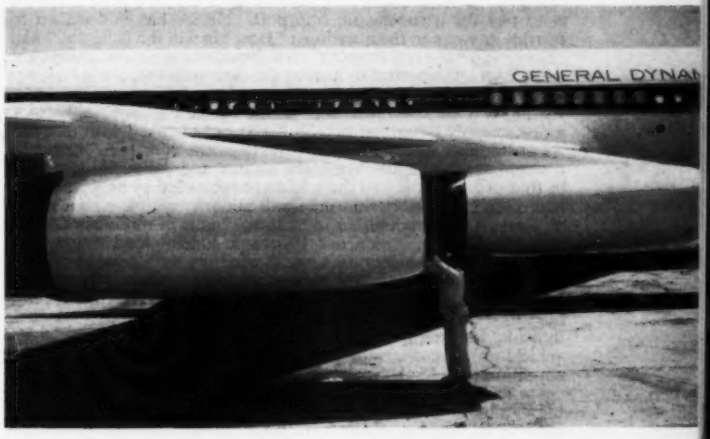
The applicant did not appear to know what he really wanted, and the acting chairman (Mr A. H. Wilson) settled down to a friendly discussion with Tyne-Tees, explaining some of the requirements of the Act and saying that the application was too wide in scope—"I wouldn't myself," said Mr Wilson, "fancy flying to Moscow in a Dove." The Board in effect told the applicant not to worry: it was only a matter of finding the right formula.

The court was then cleared, as there were certain things of a confidential nature which the Board wished to discuss. This was the first time that the Board has had a secret session. The private questioning of an applicant—particularly a new one, when pertinent matters of public interest are likely to be discussed—could, if it becomes a habit, defeat the object of holding hearings in public. It had been hoped that the Board would only very rarely invoke its right to hold the whole or part of a case in secret.

Another rather disquieting moment occurred during hearings on the same day into Overseas Aviation's application for an extension of a London-Tunis inclusive tour licence. Again Skyways were the objectors, this time on the grounds that their scheduled services would be affected—there being, according to Skyways, no doubt that inclusive tour charter flights stole traffic from scheduled operators. Skyways handed traffic and revenue figures to the Board, and the Board allowed them to be confidential because "you wouldn't like them to be mentioned in public." The important questions arise: Is confidential information withheld from the public made available to the other parties to the case? And can any party to a case hand in an exhibit without the other parties being told of its contents?

In objecting to another Overseas Aviation application for inclusive tours from Manchester to Nice and Turin, BEA considered the scale of the operation to be unreasonable. They said, for example, that they hoped to carry 5,000 passengers this season to Turin, Milan and Nice, and the applicant was seeking to provide another 1,500 to Turin. One tour had, BEA said, been advertised by the travel agent Arrowsmith Holidays, a practice which indicated a certain level of business morality. The applicant should not now be able to plead a strong booking state to support his arguments.

The Board queried BEA's arithmetic amid some confusion, and then asked BEA directly several times whether they could carry a given number of passengers on the days in question. BEA evaded the issue, leaving the impression that either they did not know (which is unlikely) or that they were deliberately not going to give an answer. It seemed that the Board had little sympathy with a carrier who objected to someone else carrying passengers that he could not himself *demonstrate* his ability to carry.



The first meeting to be chaired by Professor Jack, the Board's new full-time chairman, took place on April 27. Maitland Drewery and Skyways were applying for inclusive tours. Maitland Drewery put forward a well-presented case for taking over from the now defunct Orion's inclusive tours from Gatwick to Perpignan. Cunard Eagle objected on the grounds of material diversion from scheduled services which, because of difficulties with the French Government, were not at present operating. But it was hoped to introduce them in the very near future, offering 4,650 seats on a twice-weekly service. Of these Cunard Eagle estimated they would sell 2,000, which they thought demonstrated a convincing availability of excess capacity. The economics of this appeared to intrigue the Board, but Cunard Eagle were unable to explain their estimate.

Skyways, in an application for inclusive tour licences, made the somewhat surprising claim that the Viking is not as popular with passengers or agents as the DC-3. The chairman pressed them to explain this but Skyways declined. The Board also asked why their tour promoter was not present—was it because they did not think the case important enough? This was a reasonable request since Skyways could not answer questions about traffic.

Professor Jack appears to be instilling a higher degree of dignity and discipline into the Board's proceedings, but applicants and objectors still seem to be treating the meetings with something less than the respect they deserve, and must receive. It is remarkable that a tour promoter could not attend a hearing, and that simple questions about traffic could not be answered; but perhaps this is a hangover from the free-and-easy days of the ATAC.

A pattern and routine of argument, counter-argument and questioning seems to be evolving. But there is a disquieting tendency for the Board to diminish the public accountability of operators by assuring them that "embarrassing" figures about their financial ability to support proposed operations need not be discussed in public. This is one of the matters that the Board is required to take into account before granting a licence, and the whole spirit of the Act and the Regulations is that operators' resources must not only be adequate but must always be seen to be adequate. Any tendency by the Board to condone coyness here must be watched closely.

AIR COMMERCE...

SUPERSONICS IN RETROSPECT

Having digested the mass of facts and opinions offered at last month's IATA Symposium on Supersonic Transport in Montreal, an independent technical observer who was present looks back at the meeting and offers his assessment of what was accomplished. The symposium is reported in some detail on pages 727-729 of this issue.

THE supersonic-transport symposium was skilfully organized and documented, with over a thousand pages of thoughtful and competent working papers, and the collective cost to the airline industry exceeded $100,000 per day. Even so, the objectives of the meeting were necessarily limited. No manufacturer is likely to offer the fruits of costly secret research to his competitors. Airlines have no such restraint in stating their operational requirements; but the manufacturers have learned that what an airline puts into operation bears little relation to the requirement it stated ten years before.

The most immediate value of such a conference is that it discovers the questions for which we have no answer. Foremost among these emerged the sonic boom, overshadowing even the question of who is to pay for a supersonic transport. NASA has undertaken to provide answers to the questions: "How big will the bang be?" and "How big a bang is tolerable?" No organization is more competent than NASA to attempt to answer the first question, but its answer to the second may not command confidence. The optimistic canvassing of solutions involving "public education" not only struck a disagreeably Orwellian note, but was out of touch with real life. As an English voice remarked: "Perhaps the education should be directed at the manufacturers, the airlines and the administrations, in that order." It is one thing to have succeeded in imposing loud and disagreeable noises on the small minority who live near major airports; it is quite another to "educate" tens of millions of Europeans and North Americans to accept sudden loud bangs (and perhaps even the occasional broken window) as a routine of daily life in city and hamlet. The supersonic transport is simply not that important, and neither is the airline industry. The unanswered questions on sonic booms prejudiced many other discussions. It is difficult, for example, to determine optimum design-range for a vehicle which, conceivably, may not be able to cruise in its design condition over land.

On technical questions generally there was much valuable meeting of minds—with the exception of the navigation-ATC-communications discussions, which took place in the usual vacuum. This was the fault of neither the participants nor the organizers; designers, navigators and controllers are each separately thinking of the optimum design of the component of a system which does not itself exist. The plea for "system design" made by *Flight* a year ago was forcibly re-stated by one of the airlines, but the most convincing argument was the discussion on navigation itself. At one point the Decca/VOR controversy flared suddenly into life, to be quickly extinguished by a vigilant chairman; nevertheless, one of the few clear things about supersonic navigation is the inadequacy of the ICAO short-range navigational aid plan.

The pleasant new extension to the terminal buildings at Elmdon Airport, Birmingham, opened by the Duchess of Kent on April 28. Floor covering is by Carpet Trades of Kidderminster.

It would have been unwise to speculate on the know-how of the different manufacturers; they all knew more than they were telling. Still, one wonders which manufacturer would be most likely to obtain US government support to build a supersonic transport. Douglas has been the leading name in air transportation for a quarter of a century; Boeing has recently emerged as the leader in jet transport; Convair has the vast resources of General Dynamics and the supersonic experience of the B-58; North American could claim that B-70 system-responsibility makes it the most qualified, despite lack of civil experience; Lockheed make a case too.

A most encouraging event, even out of the context of the meeting, was the discussion on ground handling and facilitation. One can hope that the relative neglect of this subject, so important to the passenger, is at last at an end.

Anyone who expected the symposium to write a specification must be sadly disappointed. This was never the object. The meeting was an invaluable service to the aviation industry; all concerned —airlines, manufacturers and governments—must now have a clearer idea of where they stand.

Where they are going is, of course, quite another matter. The difficulties to be overcome are so formidable that only the airline industry, which during the past 30 years has repeatedly achieved the apparently impossible, could continue to consider its feasibility. Nevertheless, most airlines will feel that the prospect of supersonic transport is less immediate, and the possibility of another subsonic generation will not be escaping attention.

PLENTY OF SEATS TO SOUTH AFRICA

TEN airlines now operate from Johannesburg to Europe—the Springbok partners (BOAC, South African Airways, Central African Airways and East African Airways), KLM, Alitalia, UAT, Scandinavian, El Al, and the South African independent Trek. Another independent, associated with the UK company Overseas Aviation and with the UK Overseas Visitors' Club, is Trans Africa Air Coach, which picks up South Africans in Lourenço Marques. Operators out of Jan Smuts Airport offer 21 flights a week, and the Springbok partnership alone has 13.

The foreign carriers have quotas below the capacity of their aircraft. KLM's Johannesburg quota is 100 passengers a week and the South African Government recently refused to increase it. Alitalia's quota was recently raised from 100 to 140 a week and UAT's from 60 to 88. It appears that the South African Government is being less restrictive towards carriers of countries that have something to offer in return: Rome is an important stop on the Springbok service, and the French have influence among African nations of the French community, and it is obviously worth South Africa's while to keep them as sweet as possible.

As on the North Atlantic route, group charter operations to South Africa are expanding. The Travellers' Facilities Club, which flies out immigrants in charter aircraft and takes travellers to Europe, averages 65 passengers a week. The Overseas Visitors' Club and TAAC, using charter aircraft to and from Lourenço Marques—each with one monthly service—add a further 35 a week on average. This makes a total of 1,820 seats. The number will rise by about 56 in mid-July when Trek Airways fly Constellations (hired from South African Airways) three times a month.

The Overseas Visitors' Club has almost concluded negotiations with Central African Airways to hire aircraft giving single fares between London and Salisbury of about £90. South Africans will have to get to Salisbury—at £21 single. This club has made an interim arrangement under which it will be provided with one aircraft in April, one in May and one in June—with discussions pending on how many will be available later.

Trek Airways—if the South African National Transport Commission approves—will hire redundant SAA Constellations (*Flight*, March 10) and cut return fares between Johannesburg and Europe to £200. Trek is a German-South African financed non-scheduled airline, which enjoys official approval. It operates 52 DC-4 flights a year, each with seats for 66. Four extra seats are to be fitted. Trek has applied to charter three South African Airways 70-seater Constellations to provide 36 more flights a year—three a month. These services would bring Trek's links with Europe to 88 a year. Trek, with seven flights a month and 122 seats a week, would do more business from Johannesburg to Europe than old-established lines like KLM, UAT and SAS. Its application to the National Transport Commission was supported by South African Airways, which is embarrassed by the unused Constellations. These expensive but obsolescent airliners stand in the hangars at Jan Smuts Airport. Although the deal with Trek has not yet been concluded, South African Airways engineers and trimmers are already refurbishing the airliners. The National Transport Commission's decision on Trek's deal with South African Airways has been delayed because the commission wanted written details of proposed fares. It is expected that single fares between South Africa and Europe will be £78 10s in the off season and £94 in season. There will be no night stops. Trek will continue its DC-4 services with frequent night stops at cut-rates of £105 single and £200 return.

Men behind the application for transatlantic air services are (left) Mr Harold Bamberg, chairman and managing director of Cunard Eagle, and (right) Sir John Brocklebank, chairman of the Cunard Steam-Ship Co

TRANSATLANTIC TEST MATCH: FIRST INNINGS

A LOAD FACTOR of more than 100 per cent was achieved in the court room at Therese House in the City on May 16, the opening day of the Air Transport Licensing Board's hearings of Cunard Eagle's transatlantic application, which was being opposed by BOAC. It seemed likely, as this issue closed for press, that the proceedings would continue beyond the two-and-a-half days allocated—to be resumed yesterday, May 24.

The contestants' places directly in front of Professor Jack and the other seven members of his Board were occupied by Cunard Eagle and by BOAC. Mr Norman Ashton Hill, director of Cunard Eagle and the applicant's main advocate, was flanked by Mr Harold Bamberg, his chairman and managing director; by Sir John Brocklebank, chairman of the Cunard Steam-Ship Co, and by Mr Donald, deputy chairman of this company. At the BOAC table sat the corporation's counsel, Mr Henry Fisher, QC, flanked by BOAC legal people.

Behind each contestant's table sat a formidable array of Cunard Eagle and BOAC executives, ready to be called upon to give evidence when required. These people included, for Cunard Eagle, the directors of operations, finance and engineering, and their US lawyer; and for BOAC, Mr Basil Smallpeice, managing director, and Mr Kenneth Staple, secretary and legal adviser.

Mr Ashton Hill appeared to be rather slower and more hesitant than usual, and those who expected robust batting in the opening overs was disappointed; he played rather a dull and unaggressive game. Cunard Eagle's experience in scheduled and charter operations was recited, and so were the resources and experience of the parent shipping company. Mr Hill recounted the history of Cunard Eagle's offspring in Bermuda and the Bahamas, how these had led to the existing mid-Atlantic services in association with BOAC, and how this year his company expected to perform 426 Atlantic crossings compared with 230 in 1960 and 65 in 1959. He spoke of Eagle's Boeing 707 order, adding that VC10 "may" be bought for 1964. In discussing terms and conditions of employment, he said in effect that Eagle's 707 pilots would get the same pay as BOAC's 707 pilots.

He then came to the essence of his case—traffic. He produced a document with a stylish red cover containing tables and graphs of North Atlantic passenger growth, copies of which had previously been supplied to the Board and to BOAC. From then on everyone else was rather in the dark. Mr Ashton Hill would say to the privileged few with copies: "If you turn to Table 12 in the green section, and refer to the last column, you will see that in 1960 . . ." There would be an impressive rustle of pages on the top table as figures were recited and notes importantly made. Those without copies were clearly feeling rather out of things.

Plenty of Traffic

The document itself was, in essence, a statement of facts about past traffic growth between Europe and USA/Canada and the UK and USA/Canada—an annual average growth rate of 20 per cent since 1950 with an average load factor of 65 per cent. It showed each carrier's share of the Europe-North American market—though not of the UK-North American market, as figures could not be obtained. It was *estimated* that BOAC's 1953-60 share of the UK-US market was 37 per cent, and of the UK-Canada market 38 per cent, with load factors respectively of 64.5 and 65 per cent.

Mr Ashton Hill hit the words "material diversion" and "wasteful duplication" for six. He thought this bit of the Act was a "hotch potch"—"where wasteful duplication begins or material diversion ends," he declared, "is very difficult to determine." (Even BOAC's counsel was later on to say that "there is perhaps some argument about what is meant by material diversion.") It is obvious that arguments provoked by these old bogy words, which should never have got into the new Act, are going to waste a great deal of the Board's time.

Mr Ashton Hill then stepped from the relatively firm wicket of facts to the notoriously sticky one of forecasts. He assumed that UK-North American traffic in 1962-65 will grow each year by 20 per cent, that BOAC's share will be 40 per cent, and that BOAC's load factor will be 65 per cent. This would mean that BOAC would carry 295,000 North Atlantic passengers in 1962, rising to 509,000 in 1965; Cunard Eagle's estimated traffic would be 39,000 in 1962 and about 62,000 in 1963, 1964 and 1965—assuming a "highly optimistic" load factor, for a new carrier, of 65 per cent. The Cunard Eagle share would be 5 to 7 per cent. Then came the key statement: "*In no year does the applicant's estimated passengers carried exceed the balance of traffic increase over the previous year available for other operators after allowing BOAC its estimated share (40 per cent) of the increase over the previous year.*" This was as near as Mr Ashton Hill got to saying there will be sufficient traffic growth for Cunard Eagle to have what they want without materially diverting traffic from BOAC.

It was indisputable, he said, that of all routes the North Atlantic was the densest, carried the most traffic and had shown the biggest increase of any in recent years. Britain had only one passenger-carrier on the North Atlantic, BOAC, but there were two American passenger-carriers—Pan American Airways and Trans World Airlines. So that there should, he submitted, be British dual participation.

The Second Day

Wednesday morning opened with a submission from BOAC that the Board "should pay very little attention" to a United Research Inc report *Competition Among US International Air Carriers*, from which Mr Ashton Hill had quoted the previous day.

Mr Ashton Hill then proceeded to sum up. "The North Atlantic route for which we have applied," he said, "is the densest in the world; the increase of traffic the most rapid." The 3m passengers on the North Atlantic in 1960 were just "a drop in the bucket" of the potential among the populations at either end of the route. The figures which Cunard Eagle had presented, he went on, were not scientific figures but estimated figures taken over a number of years—and it was not the first time that Cunard Eagle had had to estimate traffic potential on a route. "If we had always been wrong, we would not be here today." Mr Ashton Hill concluded, "If there is any route in the world which admits dual participation, it is this one—and it does so at the present time."

The bowling now passed to Mr Fisher, who asked the Board's permission to cross-examine Mr Ashton Hill. He found his length at once. "If you are granted a licence," he asked, "you say that there would be no material diversion from BOAC and pure gain to British aviation—including BOAC?" "Yes." "There would be no passengers diverted from BOAC?" "I didn't say that," said Mr Ashton Hill. "I said that there would be no material diversion, which I submit is not the same thing."

There then began a long period of defensive play, BOAC's counsel probing every aspect of the Cunard Eagle application, from the exact routes for which they had applied to—figure by figure—the data on which Cunard Eagle presented their case. Statistically better equipped, BOAC were able, on detail points, to challenge some of the assumptions on which Cunard Eagle's figures were based. But the impression remained that the bowling never really got past Mr Ashton Hill's bat.

Questions About 707 Order

Was the order for Boeing 707s, BOAC wanted to know, conditional upon this licence being granted? When were the Boeings ordered? And was there an escape clause if the application were refused? Would Mr Ashton Hill produce the written contract? "Yes," was the reply, "the contract would be produced for the Board if required." But it was a confidential document which Cunard Eagle did not wish to be made available to BOAC. There was a slender escape clause but this expired on June 7, probably before the result of the hearings was known. It was not the company's intention to exercise it and thus to accept the heavy penalties involved. "So it is true to say," Mr Fisher asked, "that your company has got to find £6m before the end of June next year?" "Yes," Mr Ashton Hill replied, "that is our commitment and some of it has been paid already."

"How was it," next asked BOAC, "that Cunard's forecast of traffic until 1965 had been based only on figures for four years?" —"They were the only ones available." Did not Cunard Eagle agree that the longer the period over which figures were studied the more accurate the forecast could be.—"Not necessarily. It depends upon the factors which had influenced traffic during that time." A very close study had been made of the figures for the four years concerned. On no occasion had the increase fallen below 25 per cent so that the annual increase estimated by Cunard Eagle of only 20 per cent could be regarded as being conservative.

Mr Fisher went on to test and probe every detail of the Cunard Eagle traffic figures.

(*This review of the hearing will be continued next week. Leading article: page 685 this issue.*)

Receiving a Viscount from Mr A. H. C. Greenwood of Vickers-Armstrongs on behalf of NZNAC is the High Commissioner for New Zealand, the Hon. T. L. McDonald. The ceremony took place at Wisley on May 12, the scene of many others that have preceded it

AIR COMMERCE . . .

DUTCH-AMERICAN QUID PRO QUO

AMERICAN acceptance of the recent Dutch request for further discussions on landing rights on the US West Coast was made conditional on the willingness of the Dutch to supply statistics about the origin of passengers carried by KLM across the Atlantic. The US point of view is that Dutch services to US territory should in the main be limited to passengers travelling between the two countries. In other words, the majority of travellers should be Dutchmen or Americans, and passengers of other nationalities flying on "beyond" services should be used only as fill-ups for the remaining seats. A further condition on which the CAB wanted agreement when the bilateral came under review on May 8 was that the Dutch would accept the American interpretation of the figures provided.

Thus, in their anxiety to obtain the West Coast traffic rights after which they have hankered for so long, it seems that the Dutch may have to provide the CAB with statistical ammunition by which their capacity might in future be limited.

Consequently the Dutch delegation has been in a difficult position from the very start of negotiations. Acceptance of the American conditions might mean that traffic rights in Los Angeles were obtained at the expense of reduced frequencies on some other services to the US. If, on the other hand, the US conditions are not accepted, the Dutch will forgo landing rights in Los Angeles, and there is still the possibility that frequencies on other services will have to be reduced.

CAPITAL'S MERGER DATE IS JUNE

VISCOUNTS in United Air Lines markings should be appearing on US routes from July 1, the date when, if legal procedures are complete, the merger between United and Capital will take effect. The merged company will continue to operate 41 ex-Capital Viscounts, and these will be overhauled at Capital's maintenance base at Washington. Overhaul and maintenance of all other aircraft will be undertaken at San Francisco.

With the merger, the United fleet will comprise thirty-seven DC-8s, eighteen Boeing 720s, forty-one Viscounts, thirty-nine DC-7s, eighty-nine DC-6s and 6Bs (including eleven DC-6Bs leased by Capital from PanAm) twenty-seven Convair 340s, three DC-3s and thirteen DC-7As and DC-6As. The first Caravelle, twenty of which are on order, will be added in July and forty Boeing 727s will reach United from late in 1963.

Since last November a United/Capital merger-planning committee has been preparing for next month's transition to a single company. All Capital's employees have been guaranteed jobs in the new merged company at no reduction in pay, and with their addition United's staff will rise to over 30,000 employees.

AIR AFRIQUE MAKES ITS BOW

YET another newly formed African carrier makes its début next month when the first of 15 DC-4s previously used by Air France and UAT on their African networks will appear in the insignia of Air Afrique. Originally conceived last year as a joint Air France/UAT subsidiary to take over the regional services of these airlines in Africa after they had been integrated, with a possible 50-50 capital distribution between Air France and UAT, Air Afrique represents a refreshing change from the status-symbol airline approach of Ghana and Guinea. This is because it is now a joint venture between Air France, UAT and 11 newly independent former French-African States who contribute 66 per cent of the airline's capital. The states concerned are the Cameroun, Republique Centrafricaine, Republic of the Congo (formerly the French Congo), the Ivory Coast, Dahomey, Gabon, Upper Volta, Mauritania, Niger, Senegal and Tchad. A recent meeting between the heads of these states at Yaounde in the Cameroun resulted in each state contributing 6 per cent of Air Afrique's working capital of 10m new francs (£723,000); Air France and UAT will each have a 17 per cent holding.

A general meeting is to be held today, May 25, at Abidjan, headquarters of Air Afrique, to appoint senior executives, including a president and a director-general. Completely autonomous operations are scheduled to begin on July 15, services being flown domestically within and between the 11 states. Future services to the Middle East, Europe and North America are also envisaged. It is not yet clear what will be the future relationship of Air Afrique to such carriers as Air Cameroun, Air Tchad, Air Gabon and Transportes Aériens du Gabon, which are already established in the states which Air Afrique will serve.

A question of some importance politically is whether the Republic of Mali can be persuaded to join its neighbours in participating in Air Afrique; not only has the British Government presented three DC-3s to Mali, but the Russians signed a contract on March 20 to supply Mali with an unspecified quantity of Il-18s, Il-14s, An-2 biplanes and Mi-4 helicopters.

THE TEAL DEAL

NOW that New Zealand is the exclusive owner of Tasman Empire Airways, ideas are being sought by which overseas services can be expanded, particularly to the US markets which the airline has coveted for so long. But before such long-range services can come into operation TEAL must re-equip, and must conclude new traffic-rights agreements, in particular with the US and France.

Two factors are likely to delay the purchase by New Zealand of big jets. The first is capital outlay. At a time when TEAL is attempting to broaden the scope of its operations beyond Tahiti, Fiji and across the Tasman Sea, the airline cannot find money to buy jets. It was made clear recently that finance would have to come from TEAL and not from New Zealand taxpayers, although the Government was "bound to be concerned with the choice of aircraft." Indications of the way that the financial wind is blowing are to be found in the deferred payment to Australia of £811,400 for the latter's share of TEAL, and the readiness of Mr McAlpine, New Zealand's Minister in charge of Civil Aviation, to consider Sir Matthew Slattery's recent proposal to lease jets to TEAL in return for further Pacific and Tasman rights for BOAC.

The other consideration is the construction of Mangere Airport on the North Island. The main 6,000ft runway should be ready for service at the end of 1962/63 and by 1964 could be extended to 10,000ft. Until it is complete, New Zealand has no airport fully suitable for long-range services.

Both airline and government are turning to air freight as a possible means of establishing new routes. A new Government committee is being set up to examine the possibilities of carrying refrigerated produce across the Pacific. Mr Wellwood Beall, vice-president of Boeing, has recently been in New Zealand with proposals for Boeing freighters, and, as reported last week, Canadair are examining pallet-loaded refrigerated containers for the CL-44.

The opportunity of flying in the Handley Page Herald was taken recently by Mr Euche Sordon, Malayan Minister of Transport, during a tour of British industry. He is seen here (right) at Gatwick on May 12 with Capt J. R. Johnson, a BOAC regional executive, Mr R. Parker, HP technical sales, and Mr R. S. Sowter, HP sales manager

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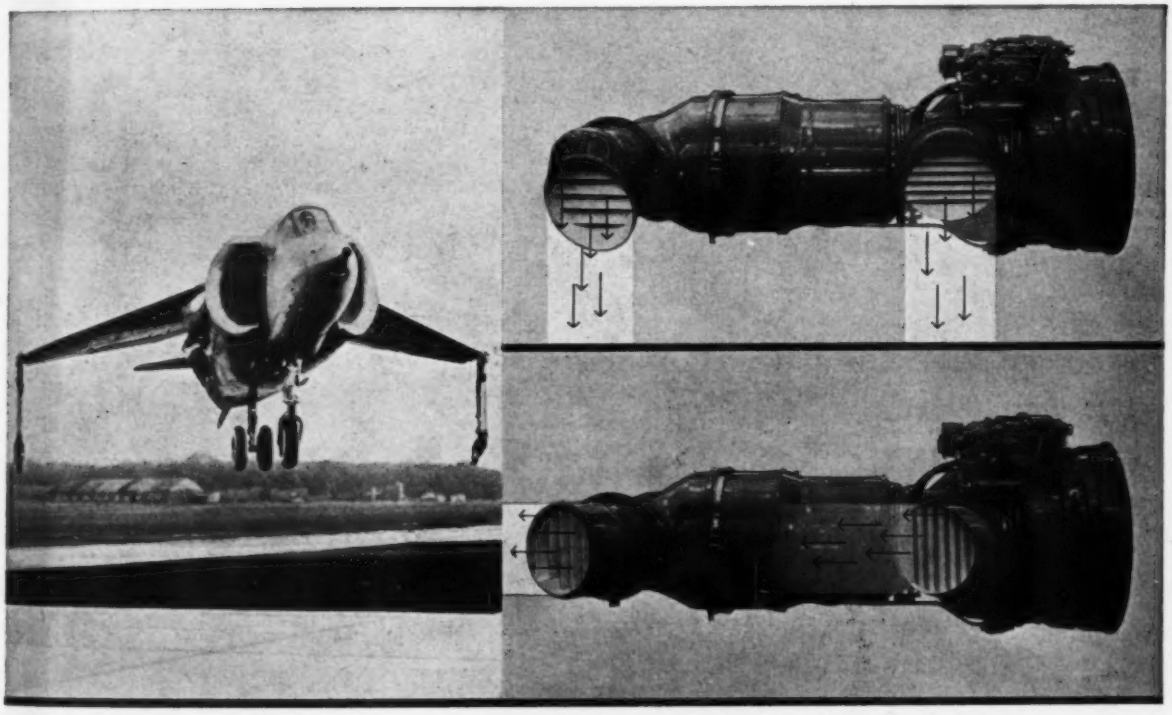

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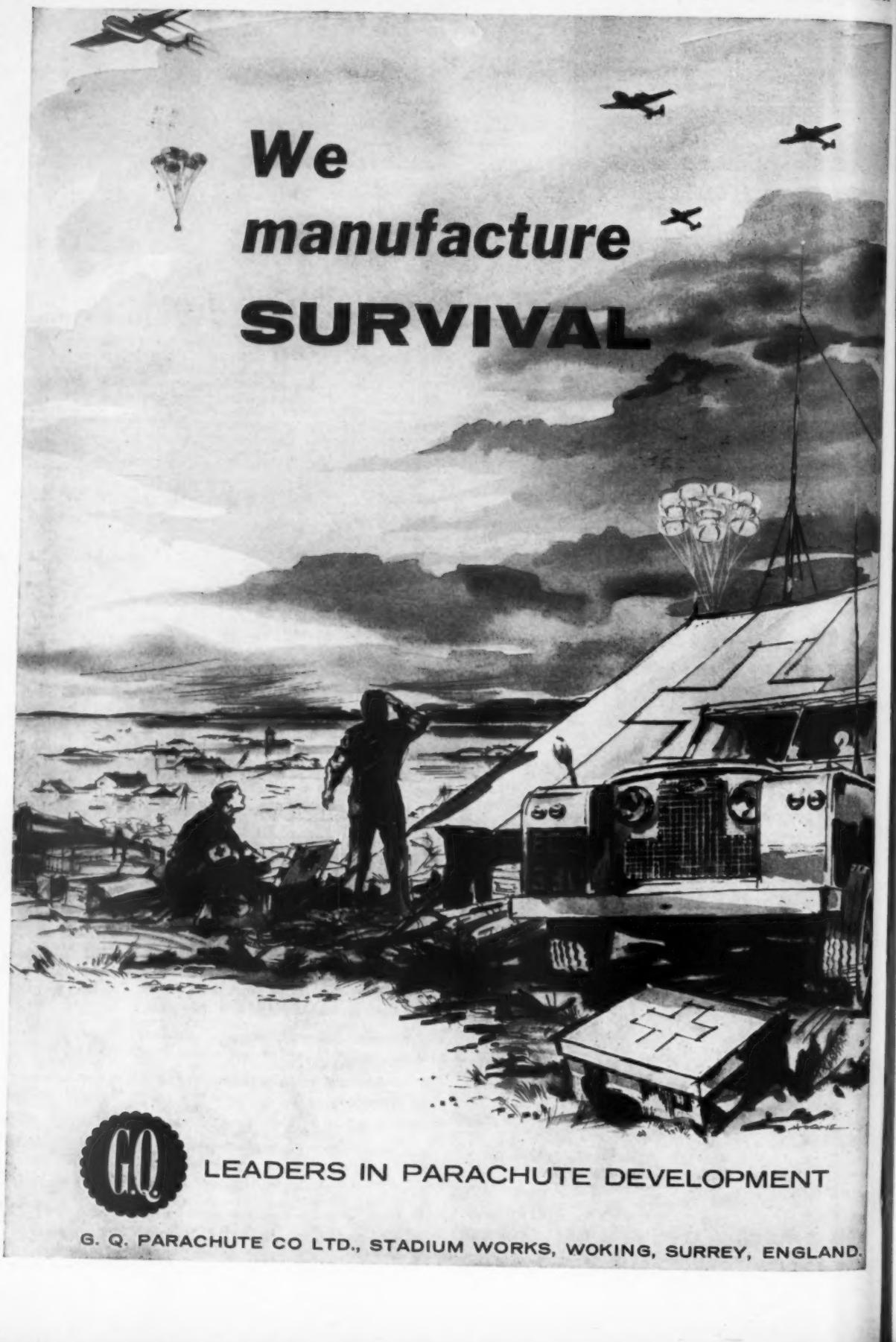
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AIR COMMERCE...

WORLD AIR TRAFFIC 1960

IF any one feature could be said to characterize world air traffic in 1960, it was the relatively poor showing of US airlines. The North American operators still carry substantially more passengers over more miles than all the rest of the free world together, but in 1960 their share declined. For the first time since the end of the Second World War United States traffic fell below 60 per cent of the world total.

Those who, a year or two ago, were forecasting an excess of capacity in the early 1960s can look back at last year in the knowledge that their prognostications have proved correct; capacity in 1960 soared by 16.5 per cent, more than in any other year since 1955, but overall load factor on scheduled services declined by 1.4 percentage points. This is the lowest figure recorded in the past decade. It was adversely influenced by the poor showing of domestic services, which had their worst-ever year for load factor—53.6 per cent. The influence of US domestic operations is always heavily felt on thel atter figures, as they represent such a high proportion of the total, and it comes as no surprise that 1960 was a lean year for US domestics. US domestic and international traffic together increased by only 7 per cent against the world gains of 20.8 per cent on international services and 8.9 per cent on domestic services.

Surplus freight capacity still exists on the world's air routes, as is indicated by passenger load factors which, at nearly 60 per cent, are appreciably greater than those for percentage of capacity filled overall. It will be interesting to examine, in 12 months' time when ICAO preliminary statistics for the year are published again, what effect IATA's new cargo rate structure (see Cargo-rate Capitulation) will have had on airline freight holds in the three closing months of the year.

If US traffic levelled off in 1960, that on the North Atlantic and in Europe and Latin America boomed. These three areas showed the year's biggest increases, reflecting the effects of much extra capacity allied to economy and excursion-type fares. On the North Atlantic, traffic increased by a quarter, accounting for nearly a third of the year's total increase in international passenger traffic. European carryings were also up by a quarter since the previous year, and Latin American airlines increased their contribution to the world's total by a fifth.

ICAO provisionally estimate that the 1960 scheduled-services fatality rate was 1.25 per 100m passenger-miles.

CARGO-RATE CAPITULATION

AT a second try, IATA scheduled airlines have reached agreement on new cargo rates across the Atlantic. As widely expected, the new rates are substantially lower than the present trucial rate applicable until June 30, and which will now be extended until the end of August.

Almost inevitably, in view of the wide disparity of viewpoint between those favouring a weight-break-only system and those advocating attractive commodity rates, from September both systems will continue in force. Commodity rates have been simplified and in a way never attempted before weight-breakpoints have been chosen to favour large consignments; it is on shipments of a ton that the big reductions take effect—61 per cent, for example, coming off the rate between London and New York. Even on small shipments the tariff has been reduced by a fifth, and commodity rates have been brought down to between 7s 8d and 5s per kg. Previously 75 commodities were covered; now there are 24 rates westbound and 15 eastbound.

Should transatlantic airlines not have reached agreement at Montreal this month, as they failed to do at Paris in February, there would from July have existed an open-rate situation, with each carrier publishing and operating its own tariff. The intentions of many carriers in this respect were published after the Paris meeting—BOAC's rate, with a high break-point at 1,000kg and a rate of 5s per kg thereafter, being among the lowest proposed. This agrees very closely with the new rates now adopted.

NORTH ATLANTIC CARGO RATES FROM SEPTEMBER 1

Route	Consignment (kg)	New rate per kg	Present rate per kg
London-New York	Under 45	15s 9d	20s
	Under 100	10s 11d	
	Under 250	7s 11d	
	Under 500	6s 6d	15s
	Under 1,000	5s 9d	13s
	Over 1,000	5s 2d	13s
	Over 7,500 (eastbound)	4s 11d	
London-Montreal	Under 45	15s 1d	19s 6d
	Under 100	10s 6d	14s 7d
	Under 250	7s 7d	
	Under 500	6s 4d	
	Under 1,000	5s 8d	12s 8d
	Over 1,000	5s 1d	12s 8d
	Over 7,500 (eastbound)	4s 10d	

BREVITIES

The fourth Comet 4C is to be delivered to United Arab Airlines on June 15 and the fifth on August 15.

The activities of Algemeen Luchtvaart Bedrijf as airbrokers and charter agents have been terminated until further notice.

VIASA has become an active member of IATA, bringing the total membership to 89.

Japan Air Lines are distributing a 5 per cent dividend following a net profit of £368,000 in the financial year ending March 31.

The establishment of a central American airline consortium came under discussion in Managua last month at a meeting of all central American airlines, including Aerovias Panama Airways.

M Georges Hereil, president and general manager of Sud Aviation, said recently that the supersonic Caravelle would be ready for service between 1967-68.

It is announced by the Babb Co, a division of International Aircraft Services Inc, that they have been appointed agents for the sale of Air France surplus spares to all companies except BOAC and BEA. Parts include those from Douglas aircraft, Viscounts and Constellations.

Starting on June 1 Dan-Air are to operate the first scheduled services ever flown out of Dundee, when DC-3s will fly direct to London Gatwick and the Isle of Man and, on July 5, to Newcastle, Liverpool, Bristol, Cardiff and Plymouth. The airfield Dan-Air will use is the Naval air station at Arbroath, HMS *Condor*, which will be known as Dundee (HMS *Condor*).

Airlines of New South Wales, a subsidiary of Ansett-ANA, are studying the DH 126 jet DC-3 replacement. This aircraft will be among one of the types studied by Mr John L. Watkins, engineering director of TAA, on his forthcoming visit to Europe. TAA require an aircraft such as the DH 126 or Super Broussard to operate routes in New Guinea, Papua and Queensland.

KLM are now operating DC-8 services through Shannon on the route between Amsterdam and New York.

President of the Institute of Transport from October 1, 1961, is to be Mr James Amos, chairman of the Scottish Omnibuses Group.

According to Gen Loginov, head of Aeroflot, the Soviet airline plans an air link with Cuba.

With effect from May 1 Mr Harald Seabrook-Smith has been appointed sales manager, charter, of Overseas Aviation, and Mr Norman Bradshaw has been appointed sales manager, scheduled services.

In Civil Aviation Licensing Notice No 23, just published, Air Safaris Ltd are applying for a passenger, cargo and mail service between Bournemouth and Glasgow or Edinburgh, with Birmingham and Liverpool as optional stops. Vikings and Hermes would be used.

A letter of intent for 25 Boeing 727s for delivery in 1964 has been signed by American Airlines. Purchase is still being negotiated with Boeing, and no details have been released, but the new order, if signed, would bring the total number of aircraft sold to 117 in less than six months. American Airlines had said previously that the 727 was too large an aeroplane for their requirements and a few months ago they were examining the DH Trident.

Visiting Smiths Aircraft Instruments on May 9 were freemen of the Guild of Air Pilots and Air Navigators

Left to right, standing: D. L. Brown, SAI, J. J. Mason, Sqn Ldr L. Bennett, Capt S. B. Beevers, Ft Lt J. R. Green, R. A. Palmer, SAI (chief test pilot), K. R. Dougan, asst (chief test pilot), Capt A. Caesar-Gordon, A. J. Macdonald, and Wg Cdr E. W. Anderson (SAI navigation adviser). Seated, left to right: J. V. Holman, C. R. Jeffs, Capt O. P. Jones, A. M. A. Majendie (Smiths aviation division deputy gen manager), Capt G. Fowkes, Capt E. W. Murray

SERVICE AVIATION

Air Force, Naval and Army Flying News

Avro Vulcan B.2s of RAF Bomber Command participated for the first time in a major air defence exercise when they took part in Exercise Matador from May 11 to 15 ("Flight," May 18). At Scampton one of these aircraft, belonging to 83 Sqn, gave a demonstration for the Press and is here seen climbing away after a "touch-and-go"

SHAPE and Wiltshire

TWO air commodores who are to become air vice-marshals on taking up new appointments are Air Cdre D. F. Spotswood, CB, CBE, DSO, DFC, ADC, and Air Cdre T. N. Coslett, OBE. Air Cdre Spotswood, who until recently has been AOC and Commandant at Cranwell, is to be Assistant Chief of Staff, Air Defence Division, Supreme Headquarters, Allied Powers Europe, from June 5. Air Cdre Coslett, Commandant of No 1 School of Technical Training at Halton since April 1958, is to be AOC No 24 Group, Technical Training Command, Chippenham, Wilts, from July 27.

Matador Co-operation

THERE was USAF-Royal Navy co-operation during Exercise Matador (*Flight* last week) when an F-100 of the 55th Tactical Fighter Squadron suffered a.s.i. failure. A Sea Vixen from Yeovilton, flown by Lt M. Darlington of 766 Sqn, was diverted to Bawdsey Control on a security frequency to assist the American fighter. Then a T-33 from Alconbury, flown by 1st Lt Jack R. Gibson, came to the assistance of the F-100, whose pilot, Capt Jack R. Lee, made a safe landing at Wethersfield.

Gen F. H. Smith, C-in-C USAFE, arriving with his wife at the RAF Church, St Clement Danes, for the dedication of a Book of Remembrance commemorating American airmen who lost their lives while UK-based during the war

Air Rank Posts

THREE air commodore postings have been announced by Air Ministry. Air Cdre R. A. C. Carter, CB, DSO, DFC, has been appointed AOA at RAF Germany (2nd TAF) headquarters. He has been Director of Personal Services (A) at Air Ministry since June 1958 and is succeeded there by Gp Capt R. E. Craven, OBE, DFC, formerly station commander at Lyneham, with the acting rank of air commodore. The third appointment is to Fighter Command, of Air Cdre H. G. Leonard-Williams, CBE, as chief signals officer. Until recently he commanded the RAF Apprentices Radio School at Locking.

RAuxAF Honour

A LONG association with the Royal Auxiliary Air Force has marked the career of the Duke of Hamilton and Brandon, whose appointment as Honorary Air Commodore of No 2 (City of Edinburgh) Maritime Headquarters Unit, RAuxAF, was announced last week. In 1927 he was first commissioned as a pilot officer with No 602 (City of Glasgow) Sqn; from 1931 to 1936 he commanded the squadron; then in 1940 he became honorary air commodore of No 945 Sqn, RAuxAF. After the war he held similar appointments, as honorary air commodore of No 602 and then of Nos 2602 and 3602 Sqns. A famous figure in the aeronautical world (he was chief pilot on the Mt Everest flight in 1933), the Duke is chairman of Scottish Aviation.

Successive Sassoon Winners

FOR the second year in succession the Sassoon Trophy, awarded on results of a bombing and navigation competition for Canberra squadrons of the Near East Air Force, has been won by No 249 Sqn. The squadron, which is commanded by Sqn Ldr D. B. Barfoot, had only a few days previously been awarded the MacDonald Trophy. This has been presented by the Near East Air Force C-in-C, Air Marshal Sir William MacDonald, for an inter-squadron aircrew sports competition.

Cooper for Southampton

AT Little Rissington recently the five southern university air squadrons competed for the Cooper Trophy. Southampton UAS were the winners, scoring 72 points in a close finish with London (70). Cambridge were third with 67.

The trophy was originally presented in 1948 by Wg Cdr Geoffrey Cooper, a wartime pilot and former MP, for competition between RAuxAF squadrons. Since their disbandment it has been competed for by the five southern university squadrons and the winners go forward to the Hack Trophy competition. Both contests are for aerobatics, spot and forced landings.

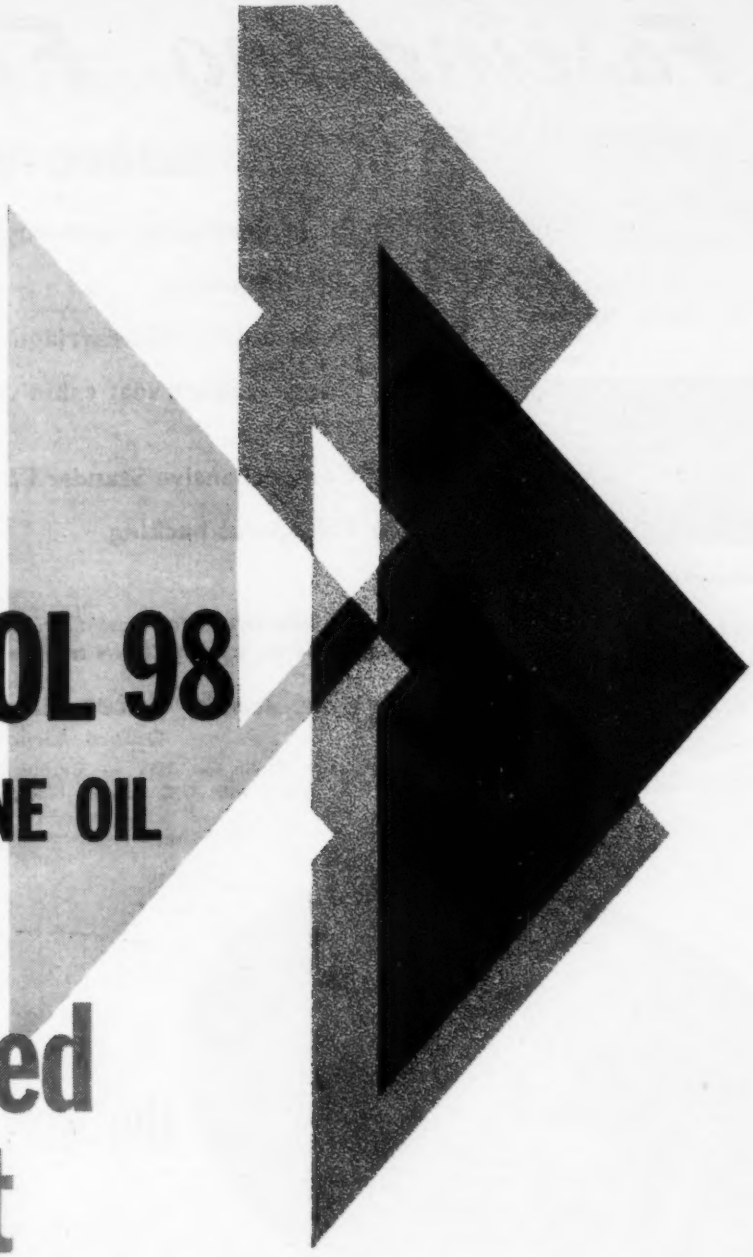
Air Marshal Sir Frederick Scherger, formerly CAS, RAAF, who becomes Chairman of the Joint Chiefs of Staff Committee on May 29, with the Administrator of Australia, Gen Sir Dallas Brooks (centre), and Senator H. Wade, Minister for Air

IN BRIEF

Aircraft from HMS *Bulwark* and *Victorious* and HMAS *Melbourne* took part in the recent Singapore air display.

A 47 Sqn reunion dinner will be held in London during August. Ex-members are cordially invited to write for full details to the Adjutant, 47 Sqn, RAF Abingdon, Berks.

Glasgow UAS have disputed the claim by Southampton University that Dr D. G. James was the first vice-chancellor to have flown in a high-performance aircraft (this page, May 11). They point out that Glasgow University vice-chancellor Sir Hector Hetherington flew in a Vampire T.11 at the age of 71 when he visited Glasgow UAS summer camp at RAF Valley in 1959.



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Supersonic Symposium

IATA EXAMINES THE PROBLEMS

HERE, from an observer at last month's IATA supersonic symposium in Montreal, is a summary of the five days of technical discussion. Some comments on the lessons to be learned from the meeting appear in the Air Commerce section of this issue of "Flight."

In the centre, R .V. Carleton (Braniff), chairman of the conference and chairman of IATA's Technical Committee. Others, left to right, are: R. D. Kelly (United), chairman of a special working group on aircraft design within the symposium; J. T. Dyment (TCA), symposium chairman; R. E. Fisher (PanAm), chairman of a working group on ground handling; and R. R. Shaw (Qantas), chairman of a working group on operations

ONLY two fundamental problems could prove to be so great that there will never be a supersonic airliner; but these two might stop the whole project cold in a way that financing difficulties and the need for international co-operation never could.

One is the problem of sonic boom, and it seemed likely from the week-long Supersonic Symposium which was the main part of IATA's 14th Technical Conference in Montreal that the world may know the answer in about a year. It became clear at the symposium—which attracted 650 engineers from 137 companies and organizations, including governments—that no one is yet certain whether the noise can be kept to something the world will tolerate. Part of the difficulty is that no one knows how much the world *will* tolerate; and everyone is afraid to do anything very direct about finding out, because they foresee the danger that the public may take a very firm line.

If the noise cannot be kept tolerable—and there was general agreement at the symposium with one airline's statement that it must be within the realm that the public will "willingly accept"—it seems there will never be a supersonic airliner, no matter whether it is the long-range Mach 2 aeroplane favoured by the British, the long-range Mach 3 the Americans are working on in early design-studies, or the short-range Mach 2 Super Caravelle which the French believe offers them a future in the field.

The other problem which may prove unmanageable is cosmic radiation at the altitudes involved—60,000ft to 80,000ft—and on this no one at the symposium was able to provide a firm answer. It was just agreed that the public is never going to get into airliners and fly at those altitudes unless it is safe, and that fear of radiation may be almost as serious a problem as radiation itself. A related problem of secondary radiation, from particles, seems much less limiting. These are not the worst altitudes for that particular problem, apparently, and they are almost wholly related to atomic testing, still at an uncertain halt.

Economics in Mind

These problems came up early in the symposium, almost immediately after warnings from delegates that the engineers and technicians must keep firmly in mind the problem of economics. R. V. Carleton, a Braniff International Airways vice-president, and chairman of the technical conference, warned that supersonic airliners could be a means of going bankrupt at supersonic speeds; and Canadian Transport Minister Leon Balcer probably spoke for more governments than his own when he warned against expecting administrations to undertake another round of heavy spending on supporting services such as the subsonic jets involved. Sir William Hildred, director-general of IATA, and Walter Binaghi, president of the ICAO council, struck somewhat similar notes. The chairman of the symposium, J. T. Dyment of Trans Canada Air Lines, probably summed up the engineering reaction neatly at the final session, when he said of these warnings: "We don't really need them. We are convinced we will have a supersonic transport, but we are smart enough to know we don't want one before we are ready for it."

What followed the economic warnings and the recognition that the sonic boom and radiation problems could possibly be too much to overcome, was a very thorough discussion of the research and development problems involved and the many implications the SST would have for the airlines using it, from flying the machine to passenger handling. In general, the mass of research and development problems reviewed by the meeting was matched by a conviction on the part of manufacturers that they can be overcome; and this was true from the question of aerodynamic heating to that of the fuels "the beast" will use. (When subsonic jets were being developed, it used to be common in North America to talk about "a new breed of cat." This newest one seems already well on the way to being labelled "the beast.") Equally generally, it was accepted that the SST must be designed within certain parameters, and these tended to be a little more orthodox as the airlines stated them than when they were being suggested by manufacturers. For example, the manufacturers seemed to be thinking about somewhat higher approach and landing speeds than the operators felt like accepting.

Again, the men who make electronic equipment seemed to have a higher opinion of its probable reliability ten years from now than the men who would use it; and this led to some differences of opinion on how far it would be possible to accept automation. The airline view was that it would require a complete pilot "override" capability and good monitoring, and this in turn drew a manufacturer's assurance that he did not propose to build an aeroplane which a human being could not fly.

The delegates went into the five-day symposium talking generally of an SST around 1970. When they emerged from the last of the five 9 a.m. to 6 p.m. sessions, they were talking more frequently of 1970-75. The intervening five days certainly produced nothing to increase the fears of airline managements that they may be confronted with an SST before the subsonic jets have paid off the bond issues that bought them. Nothing that occurred put the SST firmly into the more distant future; but the discussions did not make it seem more imminent, and they suggested a little more elasticity when talking about time.

People who asked why anyone should pay for the heavy development costs—which apparently remain at about the same stratospheric level at which they have been tentatively pegged for the last year or so—received in essence the answer that they were asking the question in the wrong place. The engineers were not prepared to accept an answer to that as part of their function, although they conceded that no airline or manufacturer can pay the price. The responsibility the members of the symposium accepted in the cost field was that the SST must be able to fly in competition with the economics of whatever other jets are in operation when it appears. The most extreme view of the improvement that can be expected in the operating costs of the jets in the next ten years—50 per cent—was left without support. It was generally assumed that the d.o.c. of the jets will come down, but on a much more modest scale than that, and one manufacturer pointed out that they are already in an advanced stage of their development.

The conference ended with a summary of the projects under serious consideration. There are three of them:—

(1) A short-range SST of Mach 2 to 2.25, put forward by the French with the qualification that if the sonic boom problem cannot be solved there will be no supersonic airliner of any range. If it can, it was argued, there will be public demand for an SST in the short to intermediate range—900 to 1,500 miles—and it will be a useful complement to a long-range SST. Its supporters accept the Mach 2 regime as involving fewer development problems, and after finding from their studies that on these ranges a Mach 3 aircraft never produced more than a 15-minute improvement in block time. The machine would be small enough to avoid runway problems; and since it would not cruise above 60,000ft it would encounter no radiation problems, should they prove to exist on a serious scale above that level. It was shown that ten years ago it was argued that the subsonic jets would be restricted to the Atlantic, but that Caravelles are in widespread use today. The SST would be known as the Super Caravelle.

(2) A Mach 2 to 2.2 aircraft with long range, put forward by the British, who argued that it had been shown throughout the symposium that no important differences existed in the technical data on which various manufacturers were basing their studies. From this starting point, it was suggested that an aluminium-titanium combination would be satisfactory for Mach 2 plus, while a steel-titanium combination would be dictated by Mach 3 and upwards, although fuel problems might limit the latter project to Mach 2.75.

The Mach 2 exponents based their case on the argument that it involved a "reasonable degree of novelty" for a practical transport. Modest development work on metals would be required and skin temperatures would be below fuel-ignition points. Fuels and non-metal

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parts might limit the steel-titanium aircraft to Mach 2.75, and even this speed would involve problems in both these fields. The step from today's speeds to Mach 2, it was argued, was actually less than from Mach 2 to Mach 3. To provide Mach 3 speeds, governments might be called on to provide many extra millions of dollars.

(3) The Mach 3 steel-titanium aircraft. The case for this, like the other two projects, was prepared by its supporting manufacturers and read by the symposium chairman before going forward to the full technical committee. The American case was that this aircraft would involve little additional research for the same flying qualities as slower aeroplanes and would be favoured by range and efficiency factors. It was argued that there is actually more experience already in the use of steel and titanium for Mach 3 than for aluminium at Mach 2, although considerably more time-temperature work was needed for both concepts. Development work by the USAF was generally aimed at Mach 3. The sonic boom problem might dictate that the transonic stage would have to be at altitudes above 40,000ft, and in this case Mach 3 was a more suitable figure. Such an aircraft would have a long service life and with new engines could move to almost Mach 4. Speed would more than offset the higher costs associated with materials development and up to a 20 per cent advantage in d.o.c.s or return on investment appeared probable.

Development problems could be solved in time for a 1970 aircraft and it was believed that customers were willing to wait until then. Growth capabilities were important, and were believed to favour this project. Without extensive new development, a Mach 2 airliner's future growth would be limited to Mach 2.5. Development of a Mach 3 design was a certainty, and hence the life of anything slower would be limited. It would be unwise to engage in a light-alloy development programme in view of the danger of early obsolescence of the materials. A steel-titanium structure would be as good from a cost-weight viewpoint, or better.

No attempt was made to reach any decision on these competing outlooks and the final statements of philosophies read from the chair were not discussed by the symposium.

Earlier, one manufacturer had told the meeting that entry of two constructors into the field, assuming they shared the market equally, would increase the purchase price of the SST by 20 to 25 per cent. No one disputed the statement.

Elevating the Pilot

A great deal about the SST itself emerged at the symposium. It will be from 185 to 200ft long, with a delta wing incorporating a straight or nearly straight trailing edge and 50° to 55° sweep on the leading edge. The nosewheel will probably be about 85ft aft of the nose, and the main landing gear will probably be double tandems.

Various pilot positions have been considered, some as unorthodox as a gondola to be lowered between the main landing wheels for ground manœuvring, take-off and landing. It seems, however, that the pilot will actually sit about where he does today, although some 40ft in the air. His height from the ground, coupled with the nosewheel distance from the nose, were considered likely to make taxying somewhat more difficult than it is today. Various tailplane arrangements have been considered, with a canard the most likely.

Engines may be either fans or turbojets, depending on a combination of factors including the boom problem, other noise considerations and the power needed for the subsonic to supersonic acceleration. Their thrust probably will be in 20,000-30,000lb range, possibly as high as 35,000lb; and if the transonic stage has to be carried out as high as 50,000-55,000ft water injection may have to be provided. There will be either four or six engines and, although none is ready today, several are well along in the development stage and their manufacturers do not foresee any insoluble problems of materials.

The engines may be either clustered in a buried mounting or be pod-mounted, but in either case they will be well back and considerably higher from the ground than today's engines—probably about 10ft. They will have variable-geometry intakes and possibly outlets, although the latter is considered much less certain. Tailpipe thrust-augmentation may be necessary for the transonic stage, but its use on take-off is not envisaged. Engine pressures will be lower and temperatures and specific fuel consumption higher for the take-off, climb and acceleration phases. The variable-geometry intakes probably will be automatically controlled, but manual override will probably be needed.

It was unanimously agreed that windows in the passenger cabin will be a requirement and that they will be much smaller than most of today's, and probably round. They may be augmented by closed-circuit television or "fibre optic" devices. The pilot will certainly have direct forward vision during taxying, take-off and landing, but not necessarily during supersonic cruise. It was argued that forward vision will not be necessary at cruise altitudes and that the actual requirements can be met by closed-circuit television or fibre optics, perhaps thereby actually improving visibility.

Passenger doors may be wider to speed up loading and unloading, since ground time will assume increased importance as speeds increase. Today's loading stairs may not be high enough, and more efficient and more easily loaded galleys will be highly desirable. Some manufacturers would like to adopt five-abreast seating in the first class, but the airlines were strongly opposed. Six-abreast economy-class seating was considered acceptable. A continuing need for first class, although as a steadily decreasing proportion of the whole, was foreseen. Manufacturers warned that volume may be extremely costly to provide in first-class cabins.

Flight frequencies will probably have to go up rather than down, and this problem will move closer to present short-haul requirements, for it appears established that, as journey-time drops, the passenger expects a better choice of frequency. One airline said it had calculated that on a North American transcontinental route where three jet frequencies were adequate today five SST frequencies would be demanded.

Question of Range

Discussion of range centred mainly around the two long-range projects and there was wide agreement that optimum figures will be dictated by North American transcontinental and transatlantic requirements. A 3,500-mile range was put forward as likely, since it would permit direct services from the US east coast to most West European centres. This would be too short for direct trans-Pacific operations, but it was felt that these would be carried out on a refuelling basis by supersonic transports rather than be left to the subsonic jets. There were suggestions, however, that a 3,500-mile range would impose some limitations on the size of the market for an SST and even more agreement that a 5,000-mile range would both increase the cost seriously and limit the market even more.

Various sizes were discussed, typical capacities being taken as 85, 125-135 and 200 passengers. Manufacturers indicated that the old rule "the bigger the aircraft the cheaper the seat-mile cost" will still hold good—perhaps even more so than in the past—but that over-capacity would be a serious problem and would cause scheduling difficulties.

The 200-passenger aeroplane would cut frequencies even on high-density routes to a possibly unacceptable degree, and would rule it completely off many routes of SST range, both through traffic and airport limitations. One manufacturer suggested a gross weight of 350,000 to 400,000lb for a 130-passenger aircraft, and there was agreement that maximum gross weight in relation to payload will be greater than with today's jets. About one-half of take-off weight will be fuel.

Discussion of a variable-geometry wing involved problems of weight and complexity but there would be low-speed-handling advantages. Ditching characteristics, a problem because of high approach-angles and speed, would be improved. Once successfully ditched, the SST should have better bouyancy characteristics, but passenger evacuation may be more difficult after any emergency; and cutting into the fuselage may be difficult with titanium, because of the problem of sparks. Rear mounting of the engines should reduce fire hazards in a crash landing. On the other hand, some of the fuel will be carried in the fuselage, although there is a hope among manufacturers that large quantities can continue to be stored in the wing. It may be necessary to use liquid nitrogen to render inert the vapour areas in the fuel tanks.

Structural Materials

The problem of the limited selection of materials for a supersonic transport, because of aerodynamic heating, was discussed initially in the context of the probable total life of the vehicle. There was general acceptance that the minimum target should be 30,000 hours, although a possible 40,000-hour life was suggested as possible with a considerable increase in cost. Some manufacturers suggested that it may be necessary to design for 50,000 hours in order to guarantee 30,000.

Presuming a structural life of 30,000 hours, it was felt that aluminium materials will not be satisfactory where temperatures of more than 250°F are encountered. This would represent a limit of about Mach 2.4 in terms of leading-edge temperatures. At Mach 3 a temperature of about 500° could be expected and at Mach 3.5 about 650° to 700°. It was recognized that there is little information on the behaviour of metals subjected to high temperatures for periods of more than 1,000 hours. Even this limited information deals mainly with unstressed test specimens and there is an accompanying need for more information on the behaviour of the materials to be used at the low end of the temperature scale, especially in relationship to crack sensitivity. The limiting effects of the non-metallic materials used, especially rubbers and sealants, was also accepted as an important factor. In addition, it would be necessary to take into account the behaviour of the materials in relation to the type of structure in which they were used.

Manufacturers felt that although a heavy amount of work remains to be done in this field the materials will be available in time for the SST. Engine makers shared this view so far as their metallurgical

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problems were concerned. It was felt, however, that airframe manufacturers will be limited to metals now existing and which can be tested in time, and that there will not be enough time to contemplate the use of completely new materials.

Significantly, a need was felt for more data on the behaviour of light as well as heavy metals. It was recognized that this data can be collected only over a fairly long time, since the exposure period in the heat problem is important.

It was stated that the B-70 programme at North American Aviation has provided some information on the behaviour of the heavier metals, but that results are not immediately available because of the lengthy processing involved. There were indications, however, that this information may show that the problem is not as serious as it had been feared.

The symposium spent some time discussing the ozone concentrations expected at cruise altitudes. These would be considerable, and their effects might be serious, although it was said there are no known cases of fatal ozone poisoning among human beings. Finally, however, it was brought out that ozone can fairly easily be destroyed or filtered-out by the use of catalytic filters and that ozone concentrations should not be a problem. This was one of the relatively few times during the symposium when a fairly serious-looking problem could be completely ruled out. An approach, however, came during the discussions of pressurization. Manufacturers reported that ram-air systems seem to offer a good standby in case of failure of the cabin pressurization system.

Fuels will also involve extensive R & D work and possibly higher costs, although information on the latter point was not firm. Quantities of fuel involved were estimated at 185,000lb for the Mach 2 SST and 190,000lb for the Mach 3. Various estimates of temperatures which bulk fuels might reach were provided. These fell into the 100-120° range for the Mach 2 project and 200-300° for the Mach 3. The temperatures obviously would vary with the type of tanks and insulation, and with whether the fuel was used as a heat-sink by the airframe designer.

It became evident that, for reasons of economics, weight and safety, fuel will be one of the major problem areas. Some hope had been expressed that current fuel types would be acceptable with an SST and there seemed to be some possibility that this might be achieved, at least with the Mach 2 design. More serious difficulties were anticipated with the Mach 3 project. Fuel suppliers warned that, while they might be able to provide the necessary thermal stability at Mach 3 temperatures without too much of a price increase, they could do so only if other characteristics remained much the same. These predictions, however, did not allow for the possibility of having to dump ageing fuel at the end of a flight. It may not be possible to mix fresh fuel with fuel which has been degraded by heat. Higher standards of cleanliness in fuel handling probably will be required because of the effect on thermal stability, and considerably more work is needed on spontaneous ignition and other factors affecting safety at the temperatures likely to be met. Airlines insisted that 25min would be a desirable refuelling goal.

It was indicated that the SST can be designed to be flown at climb angles and with g forces which will be satisfactory for passengers, but there was a clear split between manufacturers on one hand and airlines and pilots on the other on acceptable approach angles and landing speeds. Airlines were firm that today's jets have as high landing speeds as they can accept, and pilots supported this view. Rates of climb of 4,300 to 8,000ft/min were suggested, with normal rates of descent of 3,000 to 4,000ft/min. One manufacturer estimated that in extreme emergency an SST could descend from 70,000 to 40,000ft in 45sec and that below that an ultimate capability of 15,000 to 20,000ft/min could be provided. These rates would ignore considerations other than those of extreme emergency.

Discussion between airlines and manufacturers indicated that the pilot will be able to fly in a "shirt-sleeves" atmosphere on the flight deck but with a good deal of automatic aid, always with the override capability. Much air-ground communication will probably be automatic. Long-range navigation may be either Doppler-inertial or inertial, and today's short-range navaids will not be of much use except to fix position on approaching the terminal area, and in subsonic flight. Automatic landing capability will be provided, it seemed apparent, and the SST must be able to use the ILS systems in use, although it was foreseen that they will be improved by the time the aircraft appears.

It was agreed that the SST will have to fit into the ATC system of the day (although that system should be a considerable improvement over present equipment) and that it cannot expect preferential landing treatment, at least not beyond the period of introduction and initial use. It was felt that any further preferential treatment for an SST would be unacceptable to other airspace users.

W. A. W.

THE INDUSTRY

High-Speed Nameplates

PRODUCTION of nameplates and labels in anodized aluminium by a quick photographic process is a speciality of R.H. Lighting Ltd, of Anyards Road, Cobham, Surrey.

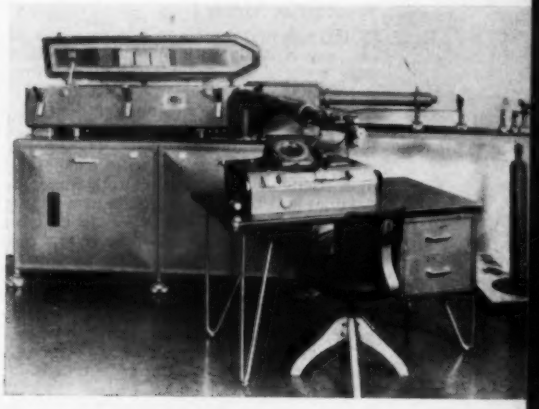
Known as Metalphoto, the product is available in two forms: the customer may order unprocessed plates and manufacture his own nameplates for labels, or he may send his artwork to the company, who will process it for him (they can also, if required, execute the artwork itself). Half-tone illustrations or linework are equally amenable to the technique.

The process—which *Flight* has seen demonstrated—is handled by R.H. Lighting as sole UK distributors for Metalphoto Corporation, of Cleveland, Ohio, and is a simple and effective one. The plate (available in a range of sizes and thicknesses) is of anodized aluminium coated with a sensitized emulsion, and is exposed for a few seconds either by contact or on an enlarger. After processing by normal photographic methods, i.e., developing for a few minutes, fixing and toning under darkroom lighting, the usual chemicals being employed, the plate is boiled for 30min. This seals the pores of the aluminium, trapping the emulsion within the anodized surface. As a result, the finished job is highly resistant to abrasion, and other advantages claimed are that the surface is non-cracking and non-peeling, resistant to salt spray and organic solvents (including aircraft hydraulic fluid) and lubricants, and non-fading.

An example of Metalphoto work by R.H. Lighting Ltd

Nameplates can also be produced in colour—e.g., red and black, green and black, or gold and black—by use of a special chemical. The image can either occupy the whole plate or a number can be printed on one plate and cut out to size afterwards. Shelf life of the unprocessed plates is two years.

Normal time for processing of customers' work by R.H. Lighting Ltd is five working days, but a while-you-wait service is available at Cobham for urgent work. A number of aircraft firms are among the company's customers.



In use at the NPL, Teddington, is this Carl Zeiss metre interference comparator which, using the wavelength of monochromatic light as a standard, can measure to one part in ten million. Zeiss agents in this country are Degenhardt & Co Ltd, of 6 Cavendish Square, London W1

IN BRIEF

Secomastic Ltd announce the appointment of Mr E. L. Townsend as chairman of the company. He is succeeded as managing director by Mr C. G. Tudor Pole.

Dewrance & Co Ltd have formed a metals division, consisting of the foundry at Hillington and special alloys division in London. Production executive is Mr J. B. Morton, situated at Hillington; Mr E. Wallace, situated in London, is sales and technical executive.

Group sales figure by the Atlas Copco Group for 1960 was a record. At £33,100,000 it represented an increase over 1959 of £6,900,000. British subsidiaries are Atlas Copco (Gt Britain) Ltd, the sales company, and Atlas Copco (Manufacturing) Ltd, which makes mobile air compressors and contractors' pneumatic tools.

Vinten Overseas Ltd is the new name for Cinematograph Export Ltd, associate company of W. Vinten Ltd, responsible for all sales outside Britain of 16mm cameras for aircraft and other specialized applications. The company will continue to operate from 715 North Circular Road, London, NW2; there is no change in directors or personnel.

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

RAF and Advisory Direct Routes

THE letter from "Airline Captain" (May 4) was rather interesting. He asks why his favourite ADR shouldn't be made an airway, or equally, why the RAF shouldn't take notice of ADRs. A number of near misses on the ADRs prompted his letter. I sympathize with him; incidents such as he described are, to put it mildly, unsettling. At the same time, I compliment him on his look-out.

Simply, airline flying with the accent on maximum safety and military flying with the emphasis on flexibility (because of its diversity and nature) are not easily reconciled. If airline flying was the *only* consideration then the whole of the UK could become a controlled airspace. If military flying was the only consideration there would be no need for airways and control zones. Result—demon compromise. The RAF keeps out of the controlled airspaces unless it conforms to the procedures. Airline traffic outside the controlled airspaces takes a calculated risk and much depends upon a good look-out by the crews concerned. Basic stuff.

If civilian traffic along a certain route outside a controlled airspace becomes heavy, an ADR is established to provide adequate separation for *that* traffic in an endeavour to reduce the number of factors making up the calculated risk. But there may be every reason why military traffic should not be excluded from that airspace, so it remains an ADR and doesn't become an airway. If, by flying along an ADR, "Airline Captain" is lulled into a false sense of security then I suggest he should use an alternative route outside the ADR where the sight of military aircraft will come as no surprise and his undoubted alertness will save the day again.

The overall picture isn't satisfactory, but no compromise can be entirely satisfactory; and provided the function and limitations of an ADR are understood they will continue to *reduce* the collision risk. "Airline Captain" experienced one of the limitations. Until the two types of flying, civilian and military, can be reconciled under some form of unified control to the satisfaction of both parties, collision risk will continue.

London NW11 DOUGLAS BRIDSON

Weather to Order?

THE rain and sun control of the whole of the South of England was brought to a head when the Russians, whose observatories were covered by cloud-banks just before the eclipse recently, suddenly sent up planes, precipitated the clouds, and gave bright sunshine for their various observatories' photography.

England is terribly behind, and this Association is to rally all those with the ability to help. The original plan (just before the eclipse) was to send up planes from Culdrose Air Station, Cornwall, in a triangular course, with supplies of "dry ice" (solid carbon dioxide) and "seed" the clouds in a zigzag 100 miles long in the zone 200 miles south-west of Land's End on a south-west wind into the sea, and produce sunshine over Cornwall and Devon, and sometimes right along to include London.

The plan now being considered is for one or more AIRSHIPS to cruise on this same route, but including West Cornwall, and dropping a score of parachute jumpers. Both "dry ice" and silver iodide come into the picture.

The Government departments are far behind and seem stunned we have taken the wind out of their sails.

Torquay, Devon C. HOWARD THOMAS
South-Western Rain and Sun Control Association

Air-India 707s in Kenya

READERS of *Flight* may be interested to have some local impressions of the arrival on April 26 of the first Air-India 707 at Nairobi on the initial proving flight from Bombay via Aden. The aircraft was VT-DJI *Nanda Devi*, commanded by Capt K. Mathen, one of the senior pilots of the airline's Boeing fleet. (Only a week previously Capt Mathen had delivered Air-India's fourth 707, VT-DMN *Kanchenjunga*, from Seattle to Bombay via London.)

VT-DJI was the first Rolls-Royce-powered 707 to be seen in East Africa. The 3,100-mile trip from Bombay to Nairobi, including the stop at Aden, took just under seven hours compared with the 14 hours previously taken by the company's Super Constellations over the same route.

On April 27 *Nanda Devi* made two local demonstration flights, carrying some 125 guests on each trip: these two flights were of one hour's duration each, and they enabled guests of Air-India to experience not only this aircraft's luxury and comfort but, in addition, to sample the joy of seeing some 2,000ft underneath them the majestic peak of Africa's highest mountain, Kilimanjaro. In perfect weather (including a gloriously blue cloudless sky) the 707 on these two local flights ascended to 26,000ft, at which t.a.s. was 570 m.p.h. The aircraft completed its proving flight by returning to Bombay at 0100hr LST on April 28.

VT-DJI was the first Boeing delivered to Air-India (February 21, 1960). The aircraft was flown back to Seattle from Bombay only two months ago for the latest modifications to be incorporated, and on its Bombay - Nairobi proving flight it carried the now familiar "fifth pod" containing a complete Conway, which will be held at Nairobi as a spare. Up to the time of its return to Seattle, VT-DJI had flown some 2,500hr in service with the airline.

On May 3 Air-India began its weekly out-and-back Bombay - Aden - Nairobi schedules: the Boeing this time was VT-DMN, which, as recorded above, had only been delivered to Bombay two weeks before. On the evening of May 4, to coincide with the first scheduled 707 flight from Nairobi to Bombay, Air-India held a colourful reception at Embakasi. Some 250 guests attended and enjoyed themselves immensely; the hosts were Mr and Mrs F. J. "Lawrie" Lawrence (Air-India regional manager, Africa) and Mr and Mrs Ernest Rodriques (station manager).

Nairobi, Kenya DENNIS POWELL

The First White Tops

IN your issue of May 11 Mr M. A. Jackson states that he is interested to know of any white-topped airliners before 1950. The Farman Goliaths used by Cie des Grands Express Aériens had white tops when they began operating to Croydon at the end of March 1920. Some of the Goliaths used by Cie des Messageries Aériennes had white fuselage tops and when these two French companies were combined to form Air Union in 1923 the white top was adopted by Air Union.

There is also some evidence that the top of the fuselage was painted white on the Goliath exhibited at the 1919 Paris Aero Show, then Exposition Internationale de Locomotion Aérienne.

London W14 JOHN STROUD

Back in Rhodesia

WITH reference to your final brevity on page 548 of your issue of April 20, just received, I can confirm that the Kariba Dam is now back in Rhodesia.

There can be little doubt that this same dam was also "at home" recently to the party of RAF cadets.

Possibly this was a friendly endeavour to save them a navigational error of some 1,200 miles, or perhaps the dam, like most Rhodesians, just likes it here.

Salisbury, S. Rhodesia G. A. FORD

Airliner Fleet Names

WHAT a splendid idea by Arthur W. Smith (Correspondence, May 11) for BOAC to christen individual VC10s with names of VCs. Let's hope the corporation will harden not their hearts and sin yet more in psychology by ignoring this.

When the VC10 was first announced I suggested to Sir George Edwards that Vickers should revive the old type name *Victoria* for it, following the revival of *Vanguard*. And giving the names as suggested by Mr Smith would be admirable. To the travelling public, naming aircraft individually gives them human interest. If BOAC had run Cunard White Star the *Queen Mary* would have remained the 531, the number under which she was built.

I've been flying round Exercise Mayflight in an RAF Britannia named *Canopus*, a famous old Imperial Airways and BOAC name. Good for the RAF!

London W14 GEOFFREY DORMAN

FORTHCOMING EVENTS

May	26-June 4	Paris Show.
May	27-28	Royal Belgian Aero Club/ANCUPA: Touring Aircraft Rally, Liège/Bierset.
May	27-28	Como Aero Club: European Air Touring Congress, Como.
May	28	East Anglian Flying Club: At Home, Ipswich Airport.
June	1	French Aero Club: Helicopter International Grand Prix, Le Bourget.
June	1-2	Verona Aero Club: Rally.
June	2	RAeS Rotorcraft Section: "Development of Stabilizing Equipment for Helicopters," by P. D. MacMahon.
June	2-3	RAeC: London - Cardiff Air Races, Panshanger - Rhoose.
June	3-4	Coulommiers Aviation Circle: 1st Brie Rally.
June	3-4	Daphiné Aero Club: Rally, Grenoble.
June	3-5	Luxembourg Aero Club: 2nd Moselle Wine Rally.
June	4	Milan and Varece Aero Clubs: 20th International Tour of Lombardy, Venegono.
June	6-15	Aviation Union of the Escaut: Aerial Tour of France.
June	9-11	"Pilgrimage of Wings" to Lourdes, Tarbes.
June	10-11	Dieppe Aero Club: International Rally.
June	10-12	Quiberon Aero Club: 7th Rally.
June	15	RN Air Station Lee-on-Solent At Home.
June	17	RN Air Station Yeovilton At Home.
June	17	Tenth Tactical Reconnaissance Wing, USAF, Open Day, RAF Alconbury.
June	17	RAeS Rotorcraft Section: Helicopter Rally and Garden Party, Dunsborough Park, Ripley, Surrey.

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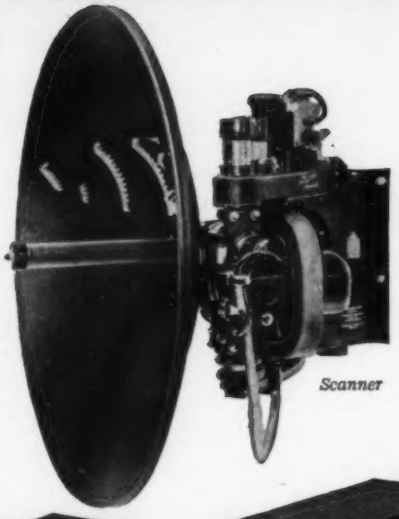
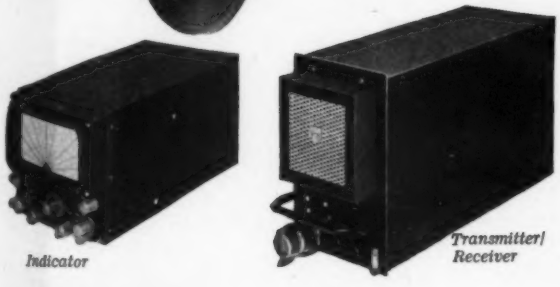


Scanner



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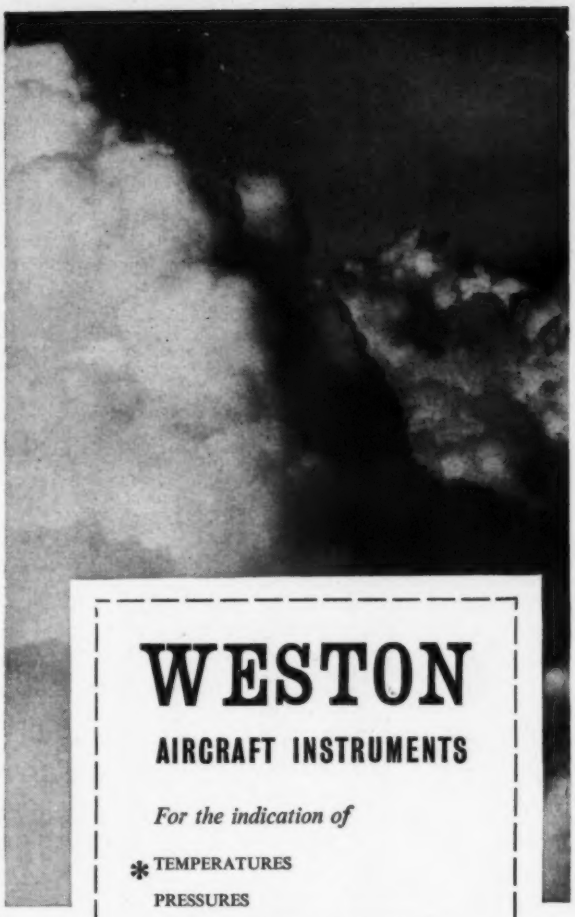

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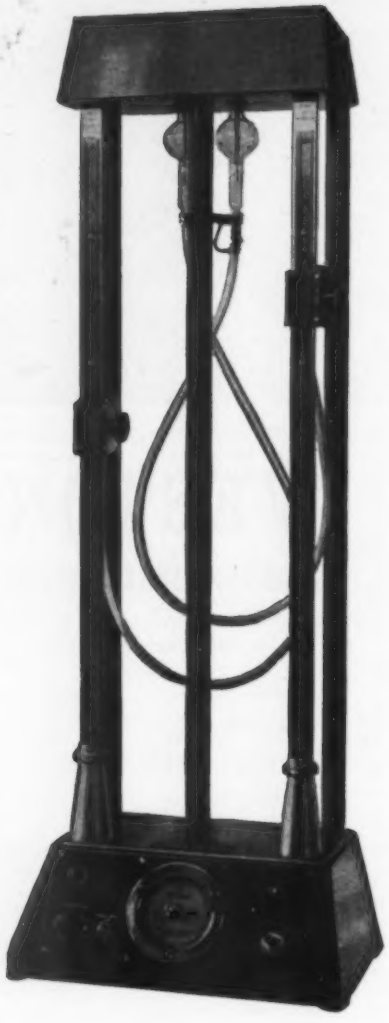

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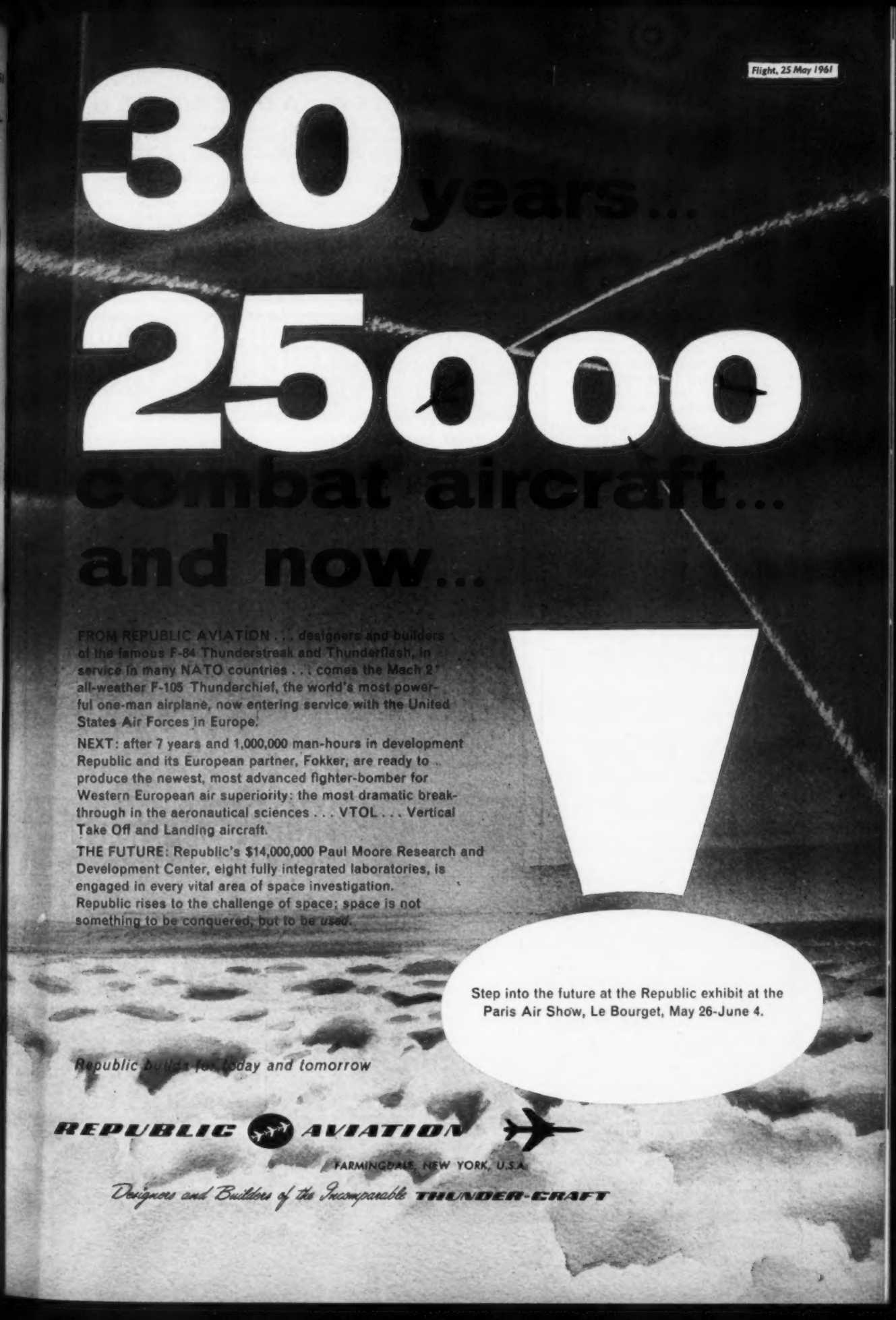
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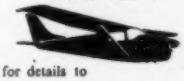

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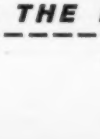

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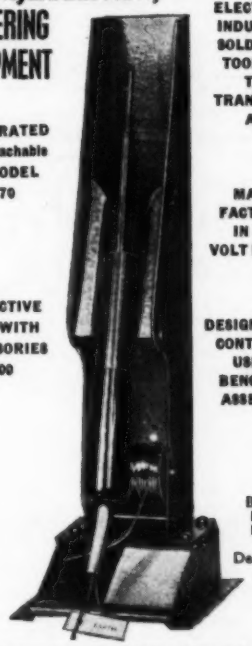

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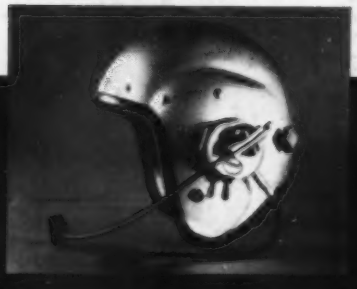

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